

## 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.

**Exception:** Buildings and structures located within the high-velocity hurricane zone shall comply with the provisions of Sections 2314 through 2330.

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

1. *Allowable stress design* in accordance with Sections 2304, 2305 and 2306.
2. *Load and resistance factor design* in accordance with Sections 2304, 2305 and 2307.
3. *Conventional light-frame construction* in accordance with Sections 2304 and 2308.

**Exception:** Buildings designed in accordance with the provisions of the AF&PA WFCM shall be deemed to meet the requirements of the provisions of Section 2308.

4. The design and construction of log structures shall be in accordance with the provisions of ICC 400.

**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.

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

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

**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 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 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, 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 (pcf) (497 kg/m<sup>3</sup>) but more than 10 pcf (160 kg/m<sup>3</sup>).

**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 American Softwood Lumber Standard 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 pcf (497 kg/m<sup>3</sup>).

**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, Alaska yellow-cedar, Eastern red cedar and both heartwood and all sapwood of Western 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 with the AF&PA NDS for glued-laminated lumber.

**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.

**PREFABRICATED WOOD I-JOIST.** Structural member manufactured using sawn or structural composite lumber flanges and wood structural panel webs bonded together with exterior exposure adhesives, which forms an “I” cross-sectional shape.

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

➔ **Shear wall, perforated.** A wood structural panel sheathed wall with openings, that has not been specifically designed and detailed for force transfer around openings.

**Shear wall segment, perforated.** A section of shear wall with full-height sheathing that meets the height-to-width ratio limits of Section 4.3.4 of AF&PA SDPWS.

**STRUCTURAL COMPOSITE LUMBER.** Structural member manufactured using wood elements bonded together with exterior adhesives. Examples of structural composite lumber are:

**Laminated veneer lumber (LVL).** A composite of wood veneer sheet elements with wood fibers primarily oriented along the length of the member.

**Parallel strand lumber (PSL).** A composite of wood strand elements with wood fibers primarily oriented along the length of the member.

**STRUCTURAL GLUED-LAMINATED TIMBER.** An engineered, stress-rated product of a timber laminating plant, comprised of assemblies of specially selected and prepared wood laminations in which the grain of all laminations is approximately parallel longitudinally and 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 and wood-based materials that use vacuum-pressure impregnation processes to enhance fire retardant or preservative properties.

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

**Preservative-treated wood.** Pressure-treated wood products that exhibit reduced susceptibility to damage 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, 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:

**Composite panels.** A wood structural panel that is comprised of wood veneer and reconstituted wood-based material and bonded together with waterproof adhesive;

**Oriented strand board (OSB).** A mat-formed wood structural panel comprised of thin rectangular wood strands arranged in cross-aligned layers with surface layers normally arranged in the long panel direction and bonded with waterproof adhesive; or

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

## SECTION 2303 MINIMUM STANDARDS AND QUALITY

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

**2303.1.1 Sawn lumber.** Sawn 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 the 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 is permitted to 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 ANSI/AITC A 190.1 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 their 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 standard. 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 is permitted to be interior type bonded with exterior glue, Exposure 1.

**2303.1.5 Fiberboard.** Fiberboard for its various uses shall conform to ASTM C 208. Fiberboard sheathing, when used structurally, shall be identified by an *approved* agency as conforming to ASTM C 208.

**2303.1.5.1 Jointing.** To ensure tight-fitting 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, fiberboard 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 walls and fire barriers, unless treated to comply with Section 803.1 for Class A 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 airspaces.

**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.

**2303.1.6 Hardboard.** Hardboard siding used structurally shall be identified by an *approved agency* conforming to CPA/ANSI 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 CPA/ANSI A135.5. Other basic hardboard products shall meet the requirements of CPA/ANSI 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 2306.5.

**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 instructions of the Composite Panel Association.

**2303.1.8 Preservative-treated wood.** Lumber, timber, plywood, piles and poles supporting permanent structures required by Section 2304.11 to be preservative treated shall conform to the requirements of the applicable AWPA Standard U1 and M4 for the species, product, preservative and end use. Preservatives shall be listed in Section 4 of AWPA U1. 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*, and shall include the following information:

1. Identification of treating manufacturer.
2. Type of preservative used.
3. Minimum preservative retention (pcf).
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.

**2303.1.10 Structural log members.** Stress grading of structural log members of nonrectangular shape, as typically used in log buildings, shall be in accordance with ASTM D 3957. Such structural log members shall be identified by the grade *mark* of an *approved* lumber grading or inspection agency. 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 shall be permitted.

**2303.1.11 Round timber poles and piles.** Round timber poles and piles shall comply with ASTM D 3200 and ASTM D 25, respectively.

**2303.2 Fire-retardant-treated wood.** *Fire-retardant-treated wood* is any wood product which, when impregnated with chemicals by a pressure process or other means during manufacture, shall have, when tested in accordance with ASTM E 84 or UL 723, a *listed* flame spread index of 25 or less and show no evidence of significant progressive combustion when the test is

continued for an additional 20-minute period. Additionally, the flame front shall not progress more than 10½ feet (3200 mm) beyond the centerline of the burners at any time during the test.

**2303.2.1 Pressure process.** For wood products impregnated with chemicals by a pressure process, the process shall be performed in closed vessels under pressures not less than 50 pounds per square inch gauge (psig) (345 kPa).

**2303.2.2 Other means during manufacture.** For wood products produced by other means during manufacture, the treatment shall be an integral part of the manufacturing process of the wood product. The treatment shall provide permanent protection to all surfaces of the wood product.

**2303.2.3 Testing.** For wood products produced by other means during manufacture, other than a pressure process, all sides of the wood product shall be tested in accordance with and produce the results required in Section 2303.2. Wood structural panels shall be permitted to test only the front and back faces.

**2303.2.4 Labeling.** Fire-retardant-treated lumber and wood structural panels shall be labeled. The *label* shall contain the following items:

1. The identification *mark* of an *approved agency* in accordance with Section 1703.5.
2. Identification of the treating manufacturer.
3. The name of the fire-retardant treatment.
4. The species of wood treated.
5. Flame spread and smoke-developed index.
6. Method of drying after treatment.
7. Conformance to appropriate standards in accordance with Sections 2303.2.5 through 2303.2.8.
8. For *fire-retardant-treated wood* exposed to weather, damp or wet locations, include the words “No increase in the *listed* classification when subjected to the Standard Rain Test” (ASTM D 2898).

**2303.2.5 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.

**2303.2.5.1 Wood structural panels.** The effect of treatment and the method of redrying after treatment, and exposure to high temperatures and high humidities on the flexure properties of fire-retardant-treated softwood plywood shall be determined in accordance with ASTM D 5516. The test data developed by ASTM D 5516 shall be used to develop adjustment factors, maximum loads and spans, or both, for untreated plywood design values in accordance with ASTM D 6305. Each manufacturer shall publish the allowable maximum loads and spans for service as floor and roof sheathing for its treatment.

**2303.2.5.2 Lumber.** For each species of wood that is treated, the effects of the treatment, the method of redrying after treatment and exposure to high temperatures and high humidities on the allowable design properties of fire-retardant-treated lumber shall be determined in accordance with ASTM D 5664. The test data developed by ASTM D 5664 shall be used to develop modification factors for use at or near room temperature and at elevated temperatures and humidity in accordance with ASTM D 6841. Each manufacturer shall publish the modification factors for service at temperatures of not less than 80°F (27°C) and for roof framing. The roof framing modification factors shall take into consideration the climatological location.

**2303.2.6 Exposure to weather, damp or wet locations.** Where *fire-retardant-treated wood* is exposed to weather, or damp or wet locations, 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.

**2303.2.7 Interior applications.** Interior *fire-retardant-treated wood* shall have moisture content of not over 28 percent when tested in accordance with ASTM D 3201 procedures at 92-percent relative humidity. Interior *fire-retardant-treated wood* shall be tested in accordance with Section 2303.2.5.1 or 2303.2.5.2. Interior *fire-retardant-treated wood* designated as Type A shall be tested in accordance with the provisions of this section.

**2303.2.8 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. For wood kiln dried after treatment (KDAT), the kiln temperatures shall not exceed those used in kiln drying the lumber and plywood submitted for the tests described in Section 2303.2.5.1 for plywood and 2303.2.5.2 for lumber.

**2303.2.9 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 and plywood.** Hardwood and decorative plywood shall be manufactured and identified as required in HPVA HP-1.

#### 2303.4 Trusses.

**2303.4.1 Design.** Wood trusses shall be designed in accordance with the provisions of this code and accepted engineering practice. Members are permitted to be joined by nails, glue, bolts, timber connectors, metal connector plates or other *approved* framing devices.

**2303.4.1.1 Truss design drawings.** The written, graphic and pictorial depiction of each individual truss shall be provided to the *building official* for approval prior to installation. Truss design drawings shall also be provided with the shipment of trusses delivered to the job site. Truss design drawings shall include, at a minimum, the information specified below:

1. Slope or depth, span and spacing;

2. Location of all joints and support locations;
3. Number of plies if greater than one;
4. Required bearing widths;
5. Design loads as applicable, including:
  - 5.1. Top chord live load;
  - 5.2. Top chord dead load;
  - 5.3. Bottom chord live load;
  - 5.4. Bottom chord dead load;
  - 5.5. Additional loads and locations; and
  - 5.6. Environmental design criteria and loads (wind, rain, etc.);
6. Other lateral loads, including drag strut loads;
7. Adjustments to wood member and metal connector plate design value for conditions of use;
8. Maximum reaction force and direction, including maximum uplift reaction forces where applicable;
9. Metal-connector-plate type, size and thickness or gage, and the dimensioned location of each metal connector plate except where symmetrically located relative to the joint interface;
10. Size, species and grade for each wood member;
11. Truss-to-truss connections and truss field assembly requirements;
12. Calculated span-to-deflection ratio and maximum vertical and horizontal deflection for live and total load as applicable;
13. Maximum axial tension and compression forces in the truss members; and
14. Required permanent individual truss member restraint location and the method and details of restraint/bracing to be used in accordance with Section 2303.4.1.2.

**2303.4.1.2 Permanent individual truss member restraint.** Where permanent restraint of truss members is required on the truss design drawings, it shall be accomplished by one of the following methods:

1. Permanent individual truss member restraint/bracing shall be installed using standard industry lateral restraint/bracing details in accordance with generally accepted engineering practice. Locations for lateral restraint shall be identified on the truss design drawing.
2. The trusses shall be designed so that the buckling of any individual truss member is resisted internally by the individual truss through suitable means (i.e., buckling reinforcement by T-reinforcement or L-reinforcement, proprietary reinforcement, etc.). The buckling reinforcement of individual members of the trusses shall be installed as shown on the truss design drawing or on supple-

mental truss member buckling reinforcement details provided by the truss designer.

3. A project-specific permanent individual truss member restraint/bracing design shall be permitted to be specified by any *registered design professional*.

**2303.4.1.3 Trusses spanning 60 feet or greater.** The owner shall contract with any qualified *registered design professional* for the design of the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing for all trusses with clear spans 60 feet (18 288 mm) or greater.

**2303.4.1.4 Truss designer.** The individual or organization responsible for the design of trusses.

**2303.4.1.4.1 Truss design drawings.** Where required by the *registered design professional*, the *building official* or the statutes of the jurisdiction in which the project is to be constructed, each individual truss design drawing shall bear the seal and signature of the truss designer.

**Exceptions:**

1. Where a cover sheet and truss index sheet are combined into a single sheet and attached to the set of truss design drawings, the single cover/truss index sheet is the only document required to be signed and sealed by the truss designer.
2. When a cover sheet and a truss index sheet are separately provided and attached to the set of truss design drawings, the cover sheet and the truss index sheet are the only documents required to be signed and sealed by the truss designer.

**2303.4.2 Truss placement diagram.** The truss manufacturer shall provide a truss placement diagram that identifies the proposed location for each individually designated truss and references the corresponding truss design drawing. The truss placement diagram shall be provided as part of the truss submittal package, and with the shipment of trusses delivered to the job site. Truss placement diagrams that serve only as a guide for installation and do not deviate from the *permit* submittal drawings shall not be required to bear the seal or signature of the truss designer.

**2303.4.3 Truss submittal package.** The truss submittal package provided by the truss manufacturer shall consist of each individual truss design drawing, the truss placement diagram, the permanent individual truss member restraint/bracing method and details and any other structural details germane to the trusses; and, as applicable, the cover/truss index sheet.

**2303.4.4 Anchorage.** The design for the transfer of loads and anchorage of each truss to the supporting structure is the responsibility of the *registered design professional*.

**2303.4.5 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, piping, additional roofing or insulation, etc.) shall not be permitted without verification that the truss is capable of supporting such additional loading.

**2303.4.6 TPI 1 specifications.** In addition to Sections 2303.4.1 through 2303.4.5, the design, manufacture and quality assurance of metal-plate-connected wood trusses shall be in accordance with TPI 1. Job-site inspections shall be in compliance with Section 110.4, as applicable.

**2303.4.7 Truss quality assurance.** Trusses not part of a manufacturing process in accordance with either Section 2303.4.6 or a standard listed in Chapter 35, which provides requirements for quality control done under the supervision of a third-party quality control agency, shall be manufactured in compliance with Sections 1704.2 and 1704.6, as applicable.

**2303.5 Test standard for joist hangers and connectors.** For the required test standards for joist hangers and connectors, see Section 1716.1.

**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 kips per square inch (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 at least 0.099 inch (2.51 mm) but not larger than 0.142 inch (3.61 mm).

**2303.7 Shrinkage.** Consideration shall be given in design to the possible effect of cross-grain dimensional changes considered vertically which may occur in lumber fabricated in a green condition.

## 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-inch-thick (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.

**2304.3.3 Shrinkage.** Wood walls and bearing partitions shall not support more than two floors and a roof unless an analysis satisfactory to the *building official* shows that shrinkage of the wood framing will not have adverse effects on the structure or any plumbing, electrical or mechanical systems, or other equipment installed therein due to excessive shrinkage or differential movements caused by shrinkage. The analysis shall also show that the roof drainage system and the foregoing systems or equipment will not be adversely affected or, as an alternate, such systems shall be designed to accommodate the differential shrinkage or movements.

**2304.3.4 Gable endwalls.**

**2304.3.4.1 General.** Gable endwalls shall be structurally continuous between points of lateral support.

**2304.3.4.2 Cathedral endwalls.** Gable endwalls adjacent to cathedral ceilings shall be structurally continuous from the uppermost floor to the ceiling diaphragm or to the roof diaphragm.

**2304.3.4.3 Full height studs.** Full height studs may be sized using the bracing at a ceiling diaphragm for determining stud length requirements.

**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.

TABLE 2304.6  
MINIMUM THICKNESS OF WALL SHEATHING

SHEATHING TYPE	MINIMUM THICKNESS	MAXIMUM WALL STUD SPACING
Wood boards	5/8 inch	24 inches on center
Fiberboard	1/2 inch	16 inches on center
Wood structural panel	In accordance with Tables 2308.9.3(2) and 2308.9.3(3)	—
M-S “Exterior Glue” and M-2 “Exterior Glue” Particleboard	In accordance with Tables 2306.5 and 2308.9.3(4)	—
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.

**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 *Florida Building Code, Mechanical*, from flues, chimneys and fireplaces, and 6 inches (152 mm) away from flue openings.

**2304.6 Wall sheathing.** Except as provided for in Section 1405 for weatherboarding 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 or any other *approved* material of equivalent strength or durability.

**2304.6.1 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 elsewhere, but not as the exposed finish, it shall be of a type manufactured with exterior glue (Exposure 1 or Exterior). Wood structural panel wall sheathing or sid-

ing used as structural sheathing shall be capable of resisting wind pressures in accordance with Section 1609. Maximum wind speeds for wood structural panel sheathing used to resist wind pressures shall be in accordance with Table 2304.6.1 for enclosed buildings with a mean roof height not greater than 30 feet (9144 mm), an importance factor (*I*) of 1.0 and a topographic factor (*K<sub>z</sub>*) of 1.0.

**2304.6.2 Interior paneling.** Softwood wood structural panels used for interior paneling shall conform to 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 CPA/ANSI 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.

**TABLE 2304.6.1**  
**MAXIMUM *V<sub>asd</sub>* AS DETERMINED IN ACCORDANCE WITH SECTION 1609.3.1 (mph) (3-SECOND GUST) PERMITTED FOR WOOD STRUCTURAL PANEL WALL SHEATHING USED TO RESIST WIND PRESSURES<sup>a, b, c</sup>**

MINIMUM NAIL		MINIMUM WOOD STRUCTURAL PANEL SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inches)	MAXIMUM WALL STUD SPACING (inches)	PANEL NAIL SPACING		MAXIMUM <i>V<sub>asd</sub></i> AS DETERMINED IN ACCORDANCE WITH SECTION 1609.3.1		
Size	Penetration (inches)				Edges (inches o.c.)	Field (inches o.c.)	Wind exposure category		
							B	C	D
6d common (2.0" × 0.113")	1.5	24/0	3/8	16	6	12	110	90	85
		24/16	7/16	16	6	12	110	100	90
8d common (2.5" × 0.131")	1.75	24/16	7/16	16	6	12	130	110	105
						6	150	125	110
				24	6	12	110	90	85
						6	110	90	85

For SI: 1 inch = 25.4 mm, 1 mile per hour = 0.447 m/s.

- a. Panel strength axis shall be parallel or perpendicular to supports. Three-ply plywood sheathing with studs spaced more than 16 inches on center shall be applied with panel strength axis perpendicular to supports.
- b. The table is based on wind pressures acting toward and away from building surfaces in accordance with Section 30.7 of ASCE 7. Lateral requirements shall be in accordance with Section 2305 or 2308.
- c. Wood structural panels with span ratings of wall-16 or wall-24 shall be permitted as an alternative to panels with a 24/0 span rating. Plywood siding rated 16 o.c. or 24 o.c. shall be permitted as an alternative to panels with a 24/16 span rating. Wall-16 and plywood siding 16 o.c. shall be used with studs spaced a maximum of 16 inches o.c.

**TABLE 2304.7(1)**  
**ALLOWABLE SPANS FOR LUMBER FLOOR AND ROOF SHEATHING<sup>a, b</sup>**

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

For SI: 1 inch = 25.4 mm.

- a. Installation details shall conform to Sections 2304.7.1 and 2304.7.2 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 2304.7.
- c. Maximum 19-percent moisture content.

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 Lumber decking.

**2304.8.1 General.** Lumber decking shall be designed and installed in accordance with the general provisions of this code and Section 2304.8. Each piece shall be square end trimmed. When random lengths are furnished, each piece shall be square end trimmed across the face so that at least 90 percent of the pieces are within 0.5 degrees (0.00873 rad) of square. The ends of the pieces shall be permitted to be beveled up to 2 degrees (0.0349 rad) from the vertical with the exposed face of the piece slightly longer than the opposite face of the piece. Tongue-and-groove decking shall be installed with the tongues up on sloped or pitched roofs with pattern faces down.

**2304.8.2 Layup patterns.** Lumber decking is permitted to be laid up following one of five standard patterns as defined in Sections 2304.8.2.1 through 2304.8.2.5. Other patterns are permitted to be used provided they are substantiated through engineering analysis.

**2304.8.2.1 Simple span pattern.** All pieces shall be supported on their ends (i.e., by two supports).

**2304.8.2.2 Two-span continuous pattern.** All pieces shall be supported by three supports, and all end joints shall occur in line on alternating supports. Supporting members shall be designed to accommodate the load redistribution caused by this pattern.

**2304.8.2.3 Combination simple and two-span continuous pattern.** Courses in end spans shall be alternating simple-span pattern and two-span continuous pattern. End joints shall be staggered in adjacent courses and shall bear on supports.

**2304.8.2.4 Cantilevered pieces intermixed pattern.** The decking shall extend across a minimum of three spans. Pieces in each starter course and every third course shall be simple span pattern. Pieces in other courses shall be cantilevered over the supports with end joints at alternating quarter or third points of the spans. Each piece shall bear on at least one support.

**2304.8.2.5 Controlled random pattern.** The decking shall extend across a minimum of three spans. End joints of pieces within 6 inches (152 mm) of the end joints of the adjacent pieces in either direction shall be separated by at least two intervening courses. In the end bays, each piece shall bear on at least one support. Where an end joint occurs in an end bay, the next piece in the same course shall continue over the first inner support for at least 24 inches (610 mm). The details of the controlled

random pattern shall be as specified for each decking material in Section 2304.8.3.3, 2304.8.4.3 or 2304.8.5.3.

Decking that cantilevers beyond a support for a horizontal distance greater than 18 inches (457 mm), 24 inches (610 mm) or 36 inches (914 mm) for 2-inch (51 mm), 3-inch (76 mm) and 4-inch (102 mm) nominal thickness decking, respectively, shall comply with the following:

1. The maximum cantilevered length shall be 30 percent of the length of the first adjacent interior span.
2. A structural fascia shall be fastened to each decking piece to maintain a continuous, straight line.
3. There shall be no end joints in the decking between the cantilevered end of the decking and the centerline of the first adjacent interior span.

### 2304.8.3 Mechanically laminated decking.

**2304.8.3.1 General.** Mechanically laminated decking consists of square-edged dimension lumber laminations set on edge and nailed to the adjacent pieces and to the supports.

**2304.8.3.2 Nailing.** The length of nails connecting laminations shall not be less than two and one-half times the net thickness of each lamination. Where decking supports are 48 inches (1219 mm) on center (o.c.) or less, side nails shall be installed not more than 30 inches (762 mm) o.c. alternating between top and bottom edges, and staggered one-third of the spacing in adjacent laminations. Where supports are spaced more than 48 inches (1219 mm) o.c., side nails shall be installed not more than 18 inches (457 mm) o.c. alternating between top and bottom edges and staggered one-third of the spacing in adjacent laminations. Two side nails shall be installed at each end of butt-jointed pieces.

Laminations shall be toenailed to supports with 20d or larger common nails. Where the supports are 48 inches (1219 mm) o.c. or less, alternate laminations shall be toenailed to alternate supports; where supports are spaced more than 48 inches (1219 mm) o.c., alternate laminations shall be toenailed to every support.

**2304.8.3.3 Controlled random pattern.** There shall be a minimum distance of 24 inches (610 mm) between end joints in adjacent courses. The pieces in the first and second courses shall bear on at least two supports with end joints in these two courses occurring on alternate supports. A maximum of seven intervening courses shall be permitted before this pattern is repeated.

### 2304.8.4 Two-inch sawn tongue-and-groove decking.

**2304.8.4.1 General.** Two-inch (51 mm) decking shall have a maximum moisture content of 15 percent. Decking shall be machined with a single tongue-and-groove pattern. Each decking piece shall be nailed to each support.

**2304.8.4.2 Nailing.** Each piece of decking shall be toenailed at each support with one 16d common nail through the tongue and face-nailed with one 16d common nail.



**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<sup>a, b</sup>**

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

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kN/m<sup>2</sup>.

- Applies to panels 24 inches or wider.
- Floor and roof sheathing conforming with this table shall be deemed to meet the design criteria of Section 2304.7.
- Uniform load deflection limitations  $\frac{1}{180}$  of span under live load plus dead load,  $\frac{1}{240}$  under live load only.
- Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking unless  $\frac{1}{4}$ -inch minimum thickness underlayment or  $1\frac{1}{2}$  inches of approved cellular or lightweight concrete is placed over the subfloor, or finish floor is  $\frac{3}{4}$ -inch wood strip. Allowable uniform load based on deflection of  $\frac{1}{360}$  of span is 100 pounds per square foot except the span rating of 48 inches on center is based on a total load of 65 pounds per square foot.
- Allowable load at maximum span.
- 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.
- For  $\frac{1}{2}$ -inch panel, maximum span shall be 24 inches.
- Span is permitted to be 24 inches on center where  $\frac{3}{4}$ -inch wood strip flooring is installed at right angles to joist.
- Span is permitted to be 24 inches on center for floors where  $1\frac{1}{2}$  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)<sup>a, b</sup>**  
**(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 <sup>c</sup>	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 <sup>d</sup>	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/m<sup>2</sup>.

- 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 except allowable total uniform load for  $1\frac{1}{8}$ -inch wood structural panels over joists spaced 48 inches on center is 65 pounds per square foot. Panel edges shall have approved tongue-and-groove joints or shall be supported with blocking, unless  $1/4$ -inch minimum thickness underlayment or  $1\frac{1}{2}$  inches of approved cellular or lightweight concrete is placed over the subfloor, or finish floor is  $3/4$ -inch wood strip.
- 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)<sup>a, b</sup>**

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 <sup>c</sup>	45 <sup>c</sup>
	1/2	24	40 <sup>c</sup>	50 <sup>c</sup>
	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 <sup>c</sup>	50 <sup>c</sup>
	5/8	24	45 <sup>c</sup>	55 <sup>c</sup>
23/32, 3/4	24	60 <sup>c</sup>	65 <sup>c</sup>	

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kN/m<sup>2</sup>.

- 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.

**2304.8.4.3 Controlled random pattern.** There shall be a minimum distance of 24 inches (610 mm) between end joints in adjacent courses. The pieces in the first and second courses shall bear on at least two supports with end joints in these two courses occurring on alternate supports. A maximum of seven intervening courses shall be permitted before this pattern is repeated.

#### **2304.8.5 Three- and 4-inch sawn tongue-and-groove decking.**

**2304.8.5.1 General.** Three-inch (76 mm) and 4-inch (102 mm) decking shall have a maximum moisture content of 19 percent. Decking shall be machined with a double tongue-and-groove pattern. Decking pieces shall be interconnected and nailed to the supports.

**2304.8.5.2 Nailing.** Each piece shall be toenailed at each support with one 40d common nail and face-nailed with one 60d common nail. Courses shall be spiked to each other with 8-inch (203 mm) spikes at maximum intervals of 30 inches (762 mm) through predrilled edge holes penetrating to a depth of approximately 4 inches (102 mm). One spike shall be installed at a distance not exceeding 10 inches (254 mm) from the end of each piece.

**2304.8.5.3 Controlled random pattern.** There shall be a minimum distance of 48 inches (1219 mm) between end joints in adjacent courses. Pieces not bearing on a support are permitted to be located in interior bays provided the adjacent pieces in the same course continue over the support for at least 24 inches (610 mm). This condition shall not occur more than once in every six courses in each interior bay.

#### **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 fasteners 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 1716.1.

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

**2304.9.5 Fasteners and connectors in contact with preservative-treated and fire-retardant-treated wood.** Fasteners and connectors in contact with *preservative-treated* and *fire-retardant-treated wood* shall be in accordance with Sections 2304.9.5.1 through 2304.9.5.4. The coating

weights for zinc-coated fasteners shall be in accordance with ASTM A 153.

**2304.9.5.1 Fasteners and connectors for preservative-treated wood.** Fasteners in contact with *preservative-treated wood* shall be of hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Fasteners other than nails, timber rivets, wood screws and lag screws shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum. Connectors that are used in exterior applications and in contact with *preservative-treated wood* shall have coating types and weights in accordance with the treated wood or connector manufacturer's recommendations. In the absence of manufacturer's recommendations, a minimum of ASTM A 653, type G185 zinc-coated galvanized steel, or equivalent, shall be used.

**Exception:** Plain carbon steel fasteners in SBX/DOT and zinc borate *preservative-treated wood* in an interior, dry environment shall be permitted.

**2304.9.5.2 Fastenings for wood foundations.** Fastenings for wood foundations shall be as required in AF&PA PWF.

**2304.9.5.3 Fasteners for fire-retardant-treated wood used in exterior applications or wet or damp locations.** Fasteners for *fire-retardant-treated wood* used in exterior applications or wet or damp locations shall be of hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Fasteners other than nails, timber rivets, wood screws and lag screws shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum.

**2304.9.5.4 Fasteners for fire-retardant-treated wood used in interior applications.** Fasteners for *fire-retardant-treated wood* used in interior locations shall be in accordance with the manufacturer's recommendations. In the absence of manufacturer's recommendations, Section 2304.9.5.3 shall apply.

**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.

**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

**TABLE 2304.9.1  
FASTENING SCHEDULE**

CONNECTION	FASTENING <sup>a, m</sup>	LOCATION
1. Joist to sill or girder	3 - 8d common (2½" × 0.131") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail
2. Bridging to joist	2 - 8d common (2½" × 0.131") 2 - 3" × 0.131" nails 2 - 3" 14 gage staples	toenail each end
3. 1" × 6" subfloor or less to each joist	2 - 8d common (2½" × 0.131")	face nail
4. Wider than 1" × 6" subfloor to each joist	3 - 8d common (2½" × 0.131")	face nail
5. 2" subfloor to joist or girder	2 - 16d common (3½" × 0.162")	blind and face nail
6. Sole plate to joist or blocking	16d (3½" × 0.135") at 16" o.c. 3" × 0.131" nails at 8" o.c. 3" 14 gage staples at 12" o.c.	typical face nail
Sole plate to joist or blocking at braced wall panel	3 - 16d (3½" × 0.135") at 16" o.c. 4 - 3" × 0.131" nails at 16" o.c. 4 - 3" 14 gage staples at 16" o.c.	braced wall panels
7. Top plate to stud	2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	end nail
8. Stud to sole plate	4 - 8d common (2½" × 0.131") 4 - 3" × 0.131" nails 3 - 3" 14 gage staples  2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail  end nail
9. Double studs	16d (3½" × 0.135") at 24" o.c. 3" × 0.131" nail at 8" o.c. 3" 14 gage staple at 8" o.c.	face nail
10. Double top plates	16d (3½" × 0.135") at 16" o.c. 3" × 0.131" nail at 12" o.c. 3" 14 gage staple at 12" o.c.	typical face nail
Double top plates	8 - 16d common (3½" × 0.162") 12 - 3" × 0.131" nails 12 - 3" 14 gage staples	lap splice
11. Blocking between joists or rafters to top plate	3 - 8d common (2½" × 0.131") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail
12. Rim joist to top plate	8d (2½" × 0.131") at 6" 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 (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	face nail
14. Continuous header, two pieces	16d common (3½" × 0.162")	16" o.c. along edge
15. Ceiling joists to plate	3 - 8d common (2½" × 0.131") 5 - 3" × 0.131" nails 5 - 3" 14 gage staples	toenail
16. Continuous header to stud	4 - 8d common (2½" × 0.131")	toenail

*(continued)*

**TABLE 2304.9.1—continued  
FASTENING SCHEDULE**

CONNECTION	FASTENING <sup>a, m</sup>	LOCATION
17. Ceiling joists, laps over partitions (see Section 2308.10.4.1, Table 2308.10.4.1)	3 - 16d common (3½" × 0.162") minimum, Table 2308.10.4.1 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
18. Ceiling joists to parallel rafters (see Section 2308.10.4.1, Table 2308.10.4.1)	3 - 16d common (3½" × 0.162") minimum, Table 2308.10.4.1 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
19. Rafter to plate (see Section 2308.10.1, Table 2308.10.1)	3 - 8d common (2½" × 0.131") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail
20. 1" diagonal brace to each stud and plate	2 - 8d common (2½" × 0.131") 2 - 3" × 0.131" nails 3 - 3" 14 gage staples	face nail
21. 1" × 8" sheathing to each bearing	3 - 8d common (2½" × 0.131")	face nail
22. Wider than 1" × 8" sheathing to each bearing	3 - 8d common (2½" × 0.131")	face nail
23. Built-up corner studs	16d common (3½" × 0.162") 3" × 0.131" nails 3" 14 gage staples	24" o.c. 16" o.c. 16" o.c.
24. Built-up girder and beams	20d common (4" × 0.192") 32" o.c. 3" × 0.131" nail at 24" o.c. 3" 14 gage staple at 24" o.c.  2 - 20d common (4" × 0.192") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	face nail at top and bottom staggered on opposite sides  face nail at ends and at each splice
25. 2" planks	16d common (3½" × 0.162")	at each bearing
26. Collar tie to rafter	3 - 10d common (3" × 0.148") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail
27. Jack rafter to hip	3 - 10d common (3" × 0.148") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples  2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail  face nail
28. Roof rafter to 2-by ridge beam	2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples  2 - 16d common (3½" × 0.162") 3 - 3" × 0.131" nails 3 - 3" 14 gage staples	toenail  face nail
29. Joist to band joist	3 - 16d common (3½" × 0.162") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail

(continued)

**TABLE 2304.9.1—continued  
FASTENING SCHEDULE**

CONNECTION	FASTENING <sup>a, m</sup>	LOCATION
30. Ledger strip	3 - 16d common (3½" × 0.162") 4 - 3" × 0.131" nails 4 - 3" 14 gage staples	face nail at each joist
31. Wood structural panels and particleboard <sup>b</sup> Subfloor, roof and wall sheathing (to framing)	½" and less 6d <sup>c, 1</sup> 2 ¾" × 0.113" nail <sup>n</sup> 1 ¾" 16 gage <sup>o</sup>	6 inch o.c. edges and intermediate, 4 inch o.c. at component and cladding edge strip # Zone 3 [refer to Figure 30.5-1 of ASCE 7]
Single Floor (combination subfloor-underlayment to framing)	15/32" to 19/32" 8d common (roofs in 110-140 V <sub>asd</sub> mph (Exp. B)	
	19/32" to ¾" 8d <sup>d</sup> or 6d <sup>e</sup> 2 ¾" × 0.113" nail <sup>p</sup> 2" 16 gage <sup>p</sup>	
	7/8" to 1" 8d <sup>c</sup> 1 1/8" to 1 1/4" 10d <sup>d</sup> or 8d <sup>d</sup>	
	¾" and less 6d <sup>e</sup> 7/8" to 1" 8d <sup>e</sup> 1 1/8" to 1 1/4" 10d <sup>d</sup> or 8d <sup>e</sup>	
32. Panel siding (to framing)	½" or less 6d <sup>f</sup> 5/8" 8d <sup>f</sup>	
33. Fiberboard sheathing <sup>g</sup>	½" No. 11 gage roofing nail <sup>h</sup> 6d common nail (2" × 0.113") No. 16 gage staple <sup>i</sup> 25/32" No. 11 gage roofing nail <sup>h</sup> 8d common nail (2 1/2" × 0.131") No. 16 gage staple <sup>i</sup>	
34. Interior paneling	¼" 4d <sup>j</sup> 3/8" 6d <sup>k</sup>	

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 (6d - 2" × 0.113"; 8d - 2 1/2" × 0.131"; 10d - 3" × 0.148").
- d. Common (6d - 2" × 0.113"; 8d - 2 1/2" × 0.131"; 10d - 3" × 0.148").
- e. Deformed shank (6d - 2" × 0.113"; 8d - 2 1/2" × 0.131"; 10d - 3" × 0.148").
- f. Corrosion-resistant siding (6d - 1 7/8" × 0.106"; 8d - 2 3/8" × 0.128") or casing (6d - 2" × 0.099"; 8d - 2 1/2" × 0.113") nail.
- g. Fasteners spaced 3 inches on center at exterior edges and 6 inches on center at intermediate supports, when used as structural sheathing. Spacing shall be 6 inches on center on the edges and 12 inches on center at intermediate supports for nonstructural applications.
- 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 or 1-inch crown and 1 1/4-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 (1 1/2" × 0.080") or finish (1 1/2" × 0.072") 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 (2 1/2" × 0.113") 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 supports.

plates, or by timber splice plates affixed to the columns by 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 intertied 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 to resist uplift forces determined in accordance with Chapter 16. Such anchors shall consist of steel or iron bolts of sufficient strength to resist vertical uplift of the roof.

## 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 used above ground in the locations specified in Sections 2304.11.2.1 through 2304.11.2.7, 2304.11.3 and 2304.11.5 shall be naturally durable wood or *preservative-treated wood* using water-borne preservatives, in accordance with AWPA U1 (Commodity Specifications A or F) 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 construction (including posts, girders, joists and subfloor) shall be of naturally durable or *preservative-treated wood*.

**2304.11.2.2 Wood supported by exterior foundation walls.** 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 masonry or concrete walls shall be of approved naturally durable or preservative-treated wood.

**2304.11.2.3 Exterior walls below grade.** 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*.

**2304.11.2.4 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*.

**2304.11.2.5 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.

**2304.11.2.6 Wood siding.** Clearance between wood siding and earth on the exterior of a building shall not be less than 6 inches (152 mm) or less than 2 inches (51 mm) vertical from concrete steps, porch slabs, patio slabs and similar horizontal surfaces exposed to the weather except where siding, sheathing and wall framing are of naturally durable or *preservative-treated wood*.

**2304.11.2.7 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 fully protected from moisture 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 used in contact with the ground (exposed earth) in the locations specified in Sections 2304.11.4.1 and 2304.11.4.2 shall be naturally durable (species for both decay and termite resistance) or preservative treated using water-borne preservative.

vatives in accordance with AWPA U1 (Commodity Specifications A or F) for soil or fresh water use.

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

**2304.11.4.1 Posts or columns.** Posts and columns supporting permanent structures that are embedded in concrete that is in direct contact with the earth, embedded in concrete that is 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.

**2304.11.4.3 Decks, fences, patios, planters, or other wooden building components that directly abut the sidewall of the foundation or structure shall be constructed so as to provide:**

1. Eighteen-inch (457 mm) clearance beneath or,
2. Six-inch (152 mm) clearance between the top of the component and the exterior wall covering or,
3. Have components that are easily removable by screws or hinges to allow access for inspection of the foundation sidewall and treatment for termites.

**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 hazard of termite damage is known to be very heavy, wood floor framing shall be of naturally durable species (termite resistant) or preservative treated in accordance with AWPA U1 for the species, product preservative and end use 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 preservative treated in accordance with AWPA U1 (Commodity Specifications A or F) for soil and fresh water use.

**2304.11.8 Attic ventilation.** For *attic* ventilation, see Section 1203.2.

**2304.11.9 Under-floor ventilation (crawl space).** For under-floor ventilation (crawl space), see Section 1203.3.

**2304.11.10 Foam-plastic insulation.**

**2304.11.10.1** The provisions of Section 2603.8 shall apply to the installation of foam plastic insulation in close proximity to the ground.

**Exception:** Materials which are of naturally durable wood or are pressure treated for ground contact, and which are installed with at least 6 inches (152 mm) clear space from the structure to allow for inspection and treatment for termites.

In order to reduce chances of termite infestation, no wood, vegetation, stumps, dead roots, cardboard, trash, or other cellulose-containing material shall be buried on the building lot within 15 feet (4.6 m) of any building or the position of any building proposed to be built.

**2304.12 Long-term loading.** Wood members supporting concrete, masonry or similar materials shall be checked for the effects of long-term loading using the provisions of the AF&PA NDS. The total deflection, including the effects of long-term loading, shall be limited in accordance with Section 1604.3.1 for these supported materials.

**Exception:** Horizontal wood members supporting masonry or concrete nonstructural floor or roof surfacing not more than 4 inches (102 mm) thick need not be checked for long-term loading.

**2304.13 Preparation of building site and removal of debris.**

**2304.13.1** All building sites shall be graded to provide drainage under all portions of the building not occupied by basements.

**2304.13.2** The foundation and the area encompassed within 1 foot (305 mm) therein shall have all vegetation, stumps, dead roots, cardboard, trash, and foreign material removed and the fill material shall be free of vegetation and foreign material. The fill shall be compacted to assure adequate support of the foundation.

**2304.13.3** After all work is completed, loose wood and debris shall be completely removed from under the building and within 1 foot (305 mm) thereof. All wood forms and supports shall be completely removed. This includes, but is not limited to: wooden grade stakes, forms, contraction spacers, tub trap boxes, plumbing supports, bracing, shoring, forms, or other cellulose-containing material placed in any location where such materials are not clearly visible and readily removable prior to completion of the work. Wood shall not be stored in contact with the ground under any building.

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

**2305.1 General.** Structures using wood shear walls and diaphragms to resist wind and other lateral loads shall be designed and constructed in accordance with AF&PA SDPWS and the provisions of Sections 2305, 2306 and 2307.

**2305.1.1 Openings in shear panels.** Openings in shear panels that materially affect their strength shall be detailed



on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.

**2305.2 Diaphragm deflection.** The deflection ( $\Delta$ ) of a blocked wood structural panel diaphragm uniformly fastened throughout with staples is permitted to be calculated by using the following equation. If not uniformly fastened, the constant 0.188 (For SI: 1/1627) in the third term shall be modified accordingly.

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

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

where:

- A = Area of chord cross section, in square inches (mm<sup>2</sup>).
- B = Diaphragm width, in feet (mm).
- E = Elastic modulus of chords, in pounds per square inch (N/mm<sup>2</sup>).
- e<sub>n</sub> = Staple deformation, in inches (mm) [see Table 2305.2(1)].
- Gt = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].
- L = Diaphragm length, in feet (mm).
- v = Maximum shear due to design loads in the direction under consideration, in pounds per linear foot (plf) (N/mm).
- Δ = The calculated deflection, in inches (mm).
- Σ (Δ<sub>c</sub>X) = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance to the nearest support.

**TABLE 2305.2(1)**

**e<sub>n</sub> VALUES (inches) FOR USE IN CALCULATING DIAPHRAGM AND SHEAR WALL DEFLECTION DUE TO FASTENER SLIP (Structural I)<sup>a, c</sup>**

LOAD PER FASTENER <sup>b</sup> (pounds)	FASTENER DESIGNATIONS
	14-Ga staple x 2 inches long
60	0.011
80	0.018
100	0.028
120	0.04
140	0.053
160	0.068

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 4.448 N.

- a. Increase e<sub>n</sub> values 20 percent for plywood grades other than Structural I.
- b. Load per fastener = maximum shear per foot divided by the number of fasteners per foot at interior panel edges.
- c. Decrease e<sub>n</sub> values 50 percent for seasoned lumber (moisture content < 19 percent).

**2305.3 Shear wall deflection.** The deflection ( $\Delta$ ) of a blocked wood structural panel shear wall uniformly fastened throughout with staples is permitted to be calculated by the use of the following equation:

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

For SI: 
$$\Delta = \frac{vh^3}{3EAb} + \frac{vh}{Gt} + \frac{he_n}{407.6} + d_a \frac{h}{b}$$

where:

- A = Area of boundary element cross section in square inches (mm<sup>2</sup>) (vertical member at shear wall boundary).
- b = Wall width, in feet (mm).
- d<sub>a</sub> = Vertical elongation of overturning anchorage (including fastener slip, device elongation, anchor rod elongation, etc.) at the design shear load (v).
- E = Elastic modulus of boundary element (vertical member at shear wall boundary), in pounds per square inch (N/mm<sup>2</sup>).
- e<sub>n</sub> = Staple deformation, in inches (mm) [see Table 2305.2(1)].
- Gt = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].
- h = Wall height, in feet (mm).
- v = Maximum shear due to design loads at the top of the wall, in pounds per linear foot (N/mm).
- Δ = The calculated deflection, in inches (mm).

## SECTION 2306 ALLOWABLE STRESS DESIGN

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

**American Forest & Paper Association.**

NDS National Design Specification for Wood Construction

SDPWS Special Design Provisions for Wind and Seismic

**American Institute of Timber Construction.**

AITC 104 Typical Construction Details

AITC 110 Standard Appearance Grades for Structural Glued Laminated Timber

AITC 113 Standard for Dimensions of Structural Glued Laminated Timber

AITC 117 Standard Specifications for Structural Glued Laminated Timber of Softwood Species

AITC 119 Standard Specifications for Structural Glued Laminated Timber of Hardwood Species

**TABLE 2305.2(2)**  
**VALUES OF  $G_t$  FOR USE IN CALCULATING DEFLECTION OF WOOD STRUCTURAL PANEL SHEAR WALLS AND DIAPHRAGMS**

PANEL TYPE	SPAN RATING	VALUES OF $G_t$ (lb/in. panel depth or width)							
		OTHER				STRUCTURAL I			
		3-ply Plywood	4-ply Plywood	5-ply Plywood <sup>a</sup>	OSB	3-ply Plywood	4-ply Plywood	5-ply Plywood <sup>a</sup>	OSB
Sheathing	24/0	25,000	32,500	37,500	77,500	32,500	42,500	41,500	77,500
	24/16	27,000	35,000	40,500	83,500	35,000	45,500	44,500	83,500
	32/16	27,000	35,000	40,500	83,500	35,000	45,500	44,500	83,500
	40/20	28,500	37,000	43,000	88,500	37,000	48,000	47,500	88,500
	48/24	31,000	40,500	46,500	96,000	40,500	52,500	51,000	96,000
Single Floor	16 o.c.	27,000	35,000	40,500	83,500	35,000	45,500	44,500	83,500
	20 o.c.	28,000	36,500	42,000	87,000	36,500	47,500	46,000	87,000
	24 o.c.	30,000	39,000	45,000	93,000	39,000	50,500	49,500	93,000
	32 o.c.	36,000	47,000	54,000	110,000	47,000	61,000	59,500	110,000
	48 o.c.	50,500	65,500	76,000	155,000	65,500	85,000	83,500	155,000

	Thickness (inches)	OTHER			STRUCTURAL I		
		A-A, A-C	Marine	All Other Grades	A-A, A-C	Marine	All Other Grades
Sanded Plywood	$1/4$	24,000	31,000	24,000	31,000	31,000	31,000
	$11/32$	25,500	33,000	25,500	33,000	33,000	33,000
	$3/8$	26,000	34,000	26,000	34,000	34,000	34,000
	$15/32$	38,000	49,500	38,000	49,500	49,500	49,500
	$1/2$	38,500	50,000	38,500	50,000	50,000	50,000
	$19/32$	49,000	63,500	49,000	63,500	63,500	63,500
	$5/8$	49,500	64,500	49,500	64,500	64,500	64,500
	$23/32$	50,500	65,500	50,500	65,500	65,500	65,500
	$3/4$	51,000	66,500	51,000	66,500	66,500	66,500
	$7/8$	52,500	68,500	52,500	68,500	68,500	68,500
	1	73,500	95,500	73,500	95,500	95,500	95,500
$1 1/8$	75,000	97,500	75,000	97,500	97,500	97,500	

For SI: 1 inch = 25.4 mm, 1 pound per inch = 0.1751 N/mm.

a. Applies to plywood with five or more layers; for five-ply/three-layer plywood, use values for four ply.

ANSI/  
AITC A190.1 Structural Glued Laminated Timber  
AITC 200 Inspection Manual

**American Society of Agricultural and Biological Engineers.**

ASABE EP 484.2 Diaphragm Design of Metal-clad, Post-Frame Rectangular Buildings  
ASABE EP 486.1 Shallow Post Foundation Design  
ASABE 559 Design Requirements and Bending Properties for Mechanically Laminated Columns

**APA—The Engineered Wood Association.**

Panel Design Specification

Plywood Design Specification Supplement 1 - Design & Fabrication of Plywood Curved Panel

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

**Truss Plate Institute, Inc.**

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

**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.

**2306.1.4 Lumber decking.** The capacity of lumber decking arranged according to the patterns described in Section

2304.8.2 shall be the lesser of the capacities determined for flexure and deflection according to the formulas in Table 2306.1.4.

**TABLE 2306.1.4 ALLOWABLE LOADS FOR LUMBER DECKING**

PATTERN	ALLOWABLE AREA LOAD <sup>a, b</sup>	
	Flexure	Deflection
Simple span	$\sigma_b = \frac{8F'_b d^2}{l^2 6}$	$\sigma_\Delta = \frac{384\Delta E' d^3}{5l^4 12}$
Two-span continuous	$\sigma_b = \frac{8F'_b d^2}{l^2 6}$	$\sigma_\Delta = \frac{185\Delta E' d^3}{l^4 12}$
Combination simple- and two-span continuous	$\sigma_b = \frac{8F'_b d^2}{l^2 6}$	$\sigma_\Delta = \frac{131\Delta E' d^3}{l^4 12}$
Cantilevered pieces intermixed	$\sigma_b = \frac{20F'_b d^2}{3l^2 6}$	$\sigma_\Delta = \frac{105\Delta E' d^3}{l^4 12}$
<b>Controlled random layup</b>		
Mechanically laminated decking	$\sigma_b = \frac{20F'_b d^2}{3l^2 6}$	$\sigma_\Delta = \frac{100\Delta E' d^3}{l^4 12}$
2-inch decking	$\sigma_b = \frac{20F'_b d^2}{3l^2 6}$	$\sigma_\Delta = \frac{100\Delta E' d^3}{l^4 12}$
3-inch and 4-inch decking	$\sigma_b = \frac{20F'_b d^2}{3l^2 6}$	$\sigma_\Delta = \frac{116\Delta E' d^3}{l^4 12}$

For SI: 1 inch = 25.4 mm.

- a.  $\sigma_b$  = Allowable total uniform load limited by bending.  
 $\sigma_\Delta$  = Allowable total uniform load limited by deflection.
- b.  $d$  = Actual decking thickness.  
 $l$  = Span of decking.  
 $F'_b$  = Allowable bending stress adjusted by applicable factors.  
 $E'$  = Modulus of elasticity adjusted by applicable factors.

**2306.2 Wood diaphragms.**

**2306.2.1 Wood structural panel diaphragms.** Wood structural panel diaphragms shall be designed and constructed in accordance with AF&PA SDPWS. Wood structural panel diaphragms are permitted to resist horizontal forces using the allowable shear capacities set forth in Table 2306.2.1(1) or 2306.2.1(2). The allowable shear capacities in Tables 2306.2.1(1) and 2306.2.1(2) are permitted to be increased 40 percent for wind design.

**2306.2.2 Single diagonally sheathed lumber diaphragms.** Single diagonally sheathed lumber diaphragms shall be designed and constructed in accordance with AF&PA SDPWS.

**2306.2.3 Double diagonally sheathed lumber diaphragms.** Double diagonally sheathed lumber diaphragms shall be designed and constructed in accordance with AF&PA SDPWS.

**2306.2.4 Gypsum board diaphragm ceilings.** Gypsum board diaphragm ceilings shall be in accordance with Section 2508.5.

**2306.3 Wood structural panel shear walls.** Wood structural panel shear walls shall be designed and constructed in accordance with AF&PA SDPWS. Wood structural panel shear walls are permitted to resist horizontal forces using the allow-

able capacities set forth in Table 2306.3. Allowable capacities in Table 2306.3 are permitted to be increased 40 percent for wind design.

**2306.4 Lumber sheathed shear walls.** Single and double diagonally sheathed lumber shear walls shall be designed and constructed in accordance with AF&PA SDPWS.

**2306.5 Particleboard shear walls.** Particleboard shear walls shall be designed and constructed in accordance with AF&PA SDPWS. Particleboard shear walls shall be permitted to resist horizontal forces using the allowable shear capacities set forth in Table 2306.5. Allowable capacities in Table 2306.5 are permitted to be increased 40 percent for wind design.

**2306.6 Fiberboard shear walls.** Fiberboard shear walls shall be designed and constructed in accordance with AF&PA SDPWS. Fiberboard shear walls are permitted to resist horizontal forces using the allowable shear capacities set forth in Table 2306.6. Allowable capacities in Table 2306.6 are permitted to be increased 40 percent for wind design.

**2306.7 Shear walls sheathed with other materials.** Shear walls sheathed with portland cement plaster, gypsum lath, gypsum sheathing or gypsum board shall be designed and constructed in accordance with AF&PA SDPWS. Shear walls sheathed with these materials are permitted to resist horizontal forces using the allowable shear capacities set forth in Table 2306.7.

## 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* shall be in accordance with AF&PA NDS and AF&PA SDPWS.

**2307.1.1 Wood structural panel shear walls.** Reserved.

## SECTION 2308 CONVENTIONAL LIGHT-FRAME CONSTRUCTION

**2308.1 General.** The requirements of 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. Alternatively, compliance with AF&PA WFCM shall be permitted subject to the limitations therein and the limitations of this code. Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) not more than three *stories above grade plane* in height with a separate *means of egress* and their accessory structures shall comply with the *Florida Building Code, Residential*.

**2308.1.1 Portions exceeding limitations of conventional construction.** When portions of a building of otherwise conventional construction exceed the limits of Section

2308.2, these portions and the supporting load path shall be designed in accordance with accepted engineering practice and the provisions of this code. For the purposes of this section, the term “portions” shall mean parts of buildings containing volume and area such as a room or a series of rooms.

**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 to further limitations of Sections 2308.11 and 2308.12.

1. Buildings shall be limited to a maximum of three *stories above grade plane*.
2. Maximum floor-to-floor height shall not exceed 11 feet, 7 inches (3531 mm). Bearing wall height shall not exceed a stud height of 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/m<sup>2</sup>) for combined roof and ceiling, exterior walls, floors and partitions.

### Exceptions:

1. Subject to the limitations of Sections 2308.11.2 and 2308.12.2, stone or masonry veneer up to the lesser of 5 inches (127 mm) thick or 50 psf (2395 N/m<sup>2</sup>) and installed in accordance with Chapter 14 is permitted to a height of 30 feet (9144 mm) above a noncombustible foundation, with an additional 8 feet (2438 mm) permitted for gable ends.
2. Concrete or masonry fireplaces, heaters and chimneys shall be permitted in accordance with the provisions of this code.
- 3.2. Live loads shall not exceed 40 psf (1916 N/m<sup>2</sup>) for floors.
- 3.3. Reserved.
4. Ultimate Design Wind Speed,  $V_{ult}$  shall not exceed 115 miles per hour (mph) (44 m/s) (3-second gust).
5. Roof trusses and rafters shall not span more than 40 feet (12 192 mm) between points of vertical support.
6. Reserved.
7. Reserved.

**2308.2.1 Ultimate Design Wind Speed,  $V_{ult}$  greater than 115 mph (3-second gust).** Where the Ultimate Design Wind Speed,  $V_{ult}$  exceeds 115 mph (3-second gust), the provisions of either AF&PA WFCM, or the ICC 600 are permitted to be used. Wind speeds in Figure 1609A, 1609B, and 1609C shall be converted in accordance with Section 1609.3.1 for use with AF&PA WFCM or ICC 600.

**2308.2.2 Buildings in Seismic Design Category B, C, D or E.** Reserved.

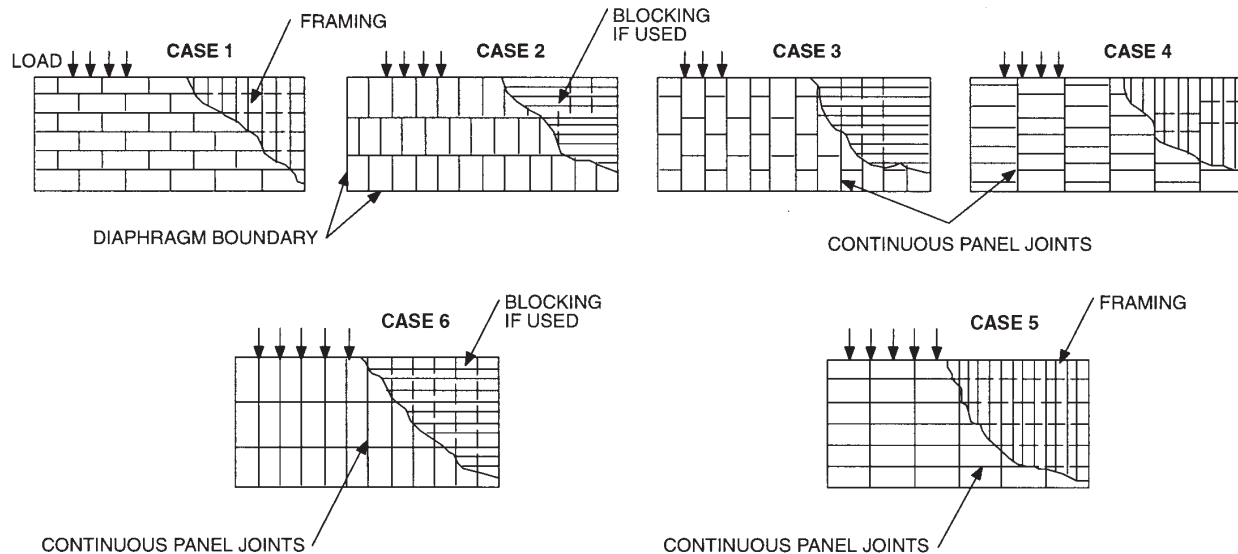
**2308.3 Braced wall lines.** Buildings shall be provided with exterior and interior braced wall lines as described in Section

TABLE 2306.2.1(1)  
ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL DIAPHRAGMS WITH  
FRAMING OF DOUGLAS FIR-LARCH, OR SOUTHERN PINE<sup>a</sup> FOR WIND LOADING<sup>b</sup>

PANEL GRADE	COMMON NAIL SIZE OR STAPLE LENGTH AND GAGE	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBERS AT ADJOINING PANEL EDGES AND BOUNDARIES <sup>9</sup> (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, 6) <sup>b</sup>						Fasteners spaced 6" max. at supported edges <sup>b</sup>			
					6		4		2 1/2 <sup>c</sup>		2 <sup>c</sup>		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) <sup>b</sup>									
					6	4	2 1/2 <sup>c</sup>	2 <sup>c</sup>						
Structural I grades	8d (2 1/2" x 0.131")	1 3/8	3/8	2	270	360	530	600	240	180				
					300	400	600	675	265	200				
	1 1/2 16 Gage	1	3/8	2	175	235	350	400	155	115				
					200	265	395	450	175	130				
	10d <sup>d</sup> (3" x 0.148")	1 1/2	3/8	2	320	425	640	730	285	215				
					360	480	720	820	320	240				
	1 1/2 16 Gage	1	15/32	2	175	235	350	400	155	120				
					200	265	395	450	175	130				
	6d <sup>e</sup> (2" x 0.113")	1 1/4	15/32	2	185	250	375	420	165	125				
					210	280	420	475	185	140				
	8d (2 1/2" x 0.131")	1 3/8	3/8	2	240	320	480	545	215	160				
					270	360	540	610	240	180				
1 1/2 16 Gage	1	3/8	2	160	210	315	360	140	105					
				180	235	355	400	160	120					
8d (2 1/2" x 0.131")	1 3/8	7/16	2	255	340	505	575	230	170					
				285	380	570	645	255	190					
1 1/2 16 Gage	1	7/16	2	165	225	335	380	150	110					
				190	250	375	425	165	125					
8d (2 1/2" x 0.131")	1 3/8	7/16	2	270	360	530	600	240	180					
				300	400	600	675	265	200					
10d <sup>d</sup> (3" x 0.148")	1 1/2	15/32	2	290	385	575	655	255	190					
				325	430	650	735	290	215					
1 1/2 16 Gage	1	15/32	2	160	210	315	360	140	105					
				180	235	355	405	160	120					
10d <sup>d</sup> (3" x 0.148")	1 1/2	15/32	2	320	425	640	730	285	215					
				360	480	720	820	320	240					
1 3/4 16 Gage	1	19/32	2	175	235	350	400	155	115					
				200	265	395	450	175	130					

continued

TABLE 2306.2.1(1)—continued  
 ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL  
 PANEL DIAPHRAGMS WITH FRAMING OF DOUGLAS FIR-LARCH,  
 OR SOUTHERN PINE<sup>a</sup> FOR WIND LOADING<sup>b</sup>



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 AF&PA NDS. (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.
- Space fasteners maximum 12 inches o.c. along intermediate framing members (6 inches o.c. where supports are spaced 48 inches o.c.).
- Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails at all panel edges shall be staggered where panel edge nailing is specified at  $2\frac{1}{2}$  inches o.c. or less.
- Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails at all panel edges shall be staggered where both of the following conditions are met: (1) 10d nails having penetration into framing of more than  $1\frac{1}{2}$  inches and (2) panel edge nailing is specified at 3 inches o.c. or less.
- 8d is recommended minimum for roofs due to negative pressures of high winds.
- Staples shall have a minimum crown width of  $\frac{7}{16}$  inch and shall be installed with their crowns parallel to the long dimension of the framing members.
- The minimum nominal width of framing members not located at boundaries or adjoining panel edges shall be 2 inches.
- For shear loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table above shall be multiplied by 0.63 or 0.56, respectively.

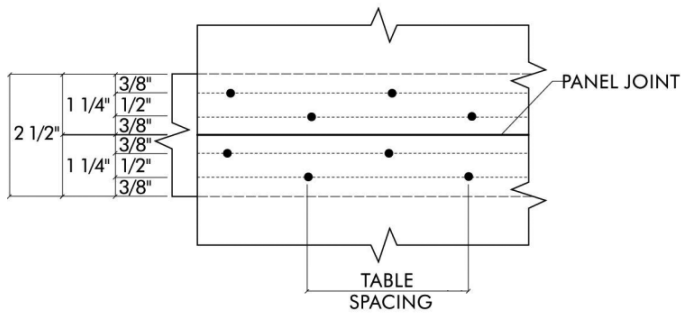
**TABLE 2306.2.1(2)**  
**ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL BLOCKED DIAPHRAGMS**  
**UTILIZING MULTIPLE ROWS OF FASTENERS (HIGH LOAD DIAPHRAGMS) WITH FRAMING OF**  
**DOUGLAS FIR-LARCH OR SOUTHERN PINE<sup>a</sup> FOR WIND LOADING<sup>b, g, h</sup>**

PANEL GRADE <sup>c</sup>	COMMON NAIL SIZE OR STAPLE <sup>f</sup> GAGE	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER AT ADJOINING PANEL EDGES AND BOUNDARIES <sup>e</sup>	LINES OF FASTENERS	BLOCKED DIAPHRAGMS					
						Cases 1 and 2 <sup>d</sup>					
						Fastener Spacing Per Line at Boundaries (inches)					
						4	2 <sup>1</sup> / <sub>2</sub>	2			
						Fastener Spacing Per Line at Other Panel Edges (inches)					
						6	4	4	3	3	2
Structural I grades	10d common nails	1 <sup>1</sup> / <sub>2</sub>	15 <sup>1</sup> / <sub>32</sub>	3	2	605	815	875	1,150	—	—
				4	2	700	915	1,005	1,290	—	—
				4	3	875	1,220	1,285	1,395	—	—
			19 <sup>1</sup> / <sub>32</sub>	3	2	670	880	965	1,255	—	—
				4	2	780	990	1,110	1,440	—	—
				4	3	965	1,320	1,405	1,790	—	—
	23 <sup>1</sup> / <sub>32</sub>	3	2	730	955	1,050	1,365	—	—		
		4	2	855	1,070	1,210	1,565	—	—		
		4	3	1,050	1,430	1,525	1,800	—	—		
	14 gage staples	2	15 <sup>1</sup> / <sub>32</sub>	3	2	600	600	860	960	1,060	1,200
				4	3	860	900	1,160	1,295	1,295	1,400
				19 <sup>1</sup> / <sub>32</sub>	3	2	600	600	875	960	1,075
			4	3	875	900	1,175	1,440	1,475	1,795	
Sheathing single floor and other grades covered in DOC PS 1 and PS 2	10d common nails	1 <sup>1</sup> / <sub>2</sub>	15 <sup>1</sup> / <sub>32</sub>	3	2	525	725	765	1,010	—	—
				4	2	605	815	875	1,105	—	—
				4	3	765	1,085	1,130	1,195	—	—
			19 <sup>1</sup> / <sub>32</sub>	3	2	650	860	935	1,225	—	—
				4	2	755	965	1,080	1,370	—	—
				4	3	935	1,290	1,365	1,485	—	—
	23 <sup>1</sup> / <sub>32</sub>	3	2	710	935	1,020	1,335	—	—		
		4	2	825	1,050	1,175	1,445	—	—		
		4	3	1,020	1,400	1,480	1,565	—	—		
	14 gage staples	2	15 <sup>1</sup> / <sub>32</sub>	3	2	540	540	735	865	915	1,080
				4	3	735	810	1,005	1,105	1,105	1,195
				19 <sup>1</sup> / <sub>32</sub>	3	2	600	600	865	960	1,065
			4	3	865	900	1,130	1,430	1,370	1,485	
			23 <sup>1</sup> / <sub>32</sub>	4	3	865	900	1,130	1,490	1,430	1,545

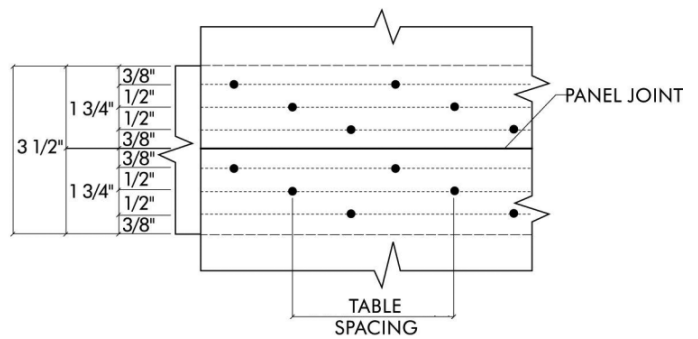
For SI: 1 inch = 25.4 mm, 1 pound per foot = 14.5939 N/m.

- a. For framing of other species: (1) Find specific gravity for species of framing lumber in AF&PA NDS. (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 of 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. Fastening along intermediate framing members: Space fasteners a maximum of 12 inches on center, except 6 inches on center for spans greater than 32 inches.
- c. Panels conforming to PS 1 or PS 2.
- d. This table gives shear values for Cases 1 and 2 as shown in Table 2306.2.1(1). The values shown are applicable to Cases 3, 4, 5 and 6 as shown in Table 2306.2.1(1), providing fasteners at all continuous panel edges are spaced in accordance with the boundary fastener spacing.
- e. The minimum nominal depth of framing members shall be 3 inches nominal. The minimum nominal width of framing members not located at boundaries or adjoining panel edges shall be 2 inches.
- f. Staples shall have a minimum crown width of 7/16 inch, and shall be installed with their crowns parallel to the long dimension of the framing members.
- g. High load diaphragms shall be subject to special inspection in accordance with Section 1704.6.1.
- h. For shear loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table above shall be multiplied by 0.63 or 0.56, respectively.

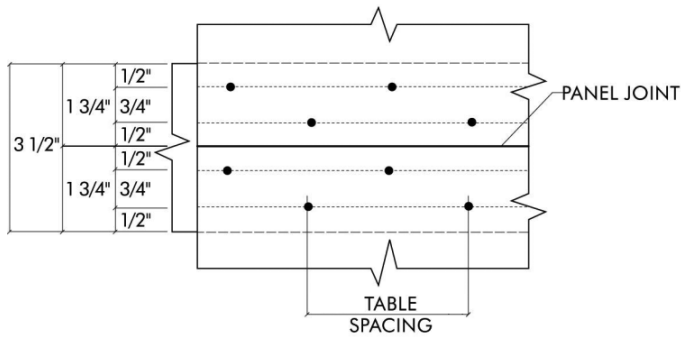
**TABLE 2306.2.1(2)—continued**  
**ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL BLOCKED DIAPHRAGMS**  
**UTILIZING MULTIPLE ROWS OF FASTENERS (HIGH LOAD DIAPHRAGMS) WITH FRAMING OF**  
**DOUGLAS FIR-LARCH OR SOUTHERN PINE FOR WIND LOADING**



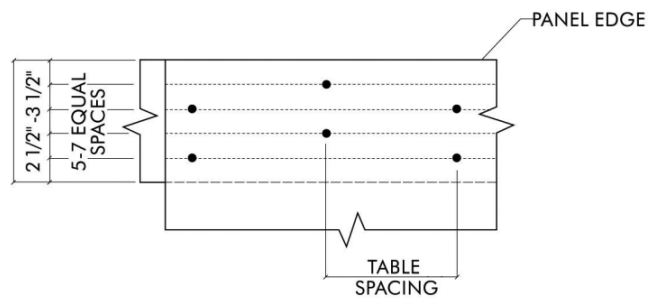
3" NOMINAL—TWO LINES



4" NOMINAL—THREE LINES



4" NOMINAL—TWO LINES



TYPICAL BOUNDARY FASTENING  
 (Shown is two lines staggered.)

NOTE: SPACE PANEL END AND EDGE JOINT 1/8-INCH. REDUCE SPACING BETWEEN LINES OF NAILS AS NECESSARY TO MAINTAIN MINIMUM 3/8-INCH FASTENER EDGE MARGINS, MINIMUM SPACING BETWEEN LINES IS 3/8-INCH



**TABLE 2306.3  
ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH  
FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE<sup>a</sup> FOR WIND LOADING<sup>b, h, i, j</sup>**

PANEL GRADE	MINIMUM NOMINAL PANEL THICKNESS (incht)	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	PANELS APPLIED DIRECT TO FRAMING				PANELS APPLIED OVER 1/2" OR 5/8" GYPSUM SHEATHING					
			NAIL (common or galvanized box or staple size)	Fastener spacing at panel edges (inches)	2 <sup>e</sup>	3	NAIL (common or galvanized box or staple size)	Fastener spacing at panel edges (inches)	2 <sup>e</sup>	3		
Structural I sheathing	3/8	3/8	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	230 <sup>d</sup>	360 <sup>d</sup>	460 <sup>d</sup>	610 <sup>d</sup>	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	280	430	550 <sup>f</sup>	730
		I	1 1/2 16 Gage	155	235	315	400	2 16 Gage	155	235	310	400
	7/16	3/8	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	255 <sup>d</sup>	395 <sup>d</sup>	505 <sup>d</sup>	670 <sup>d</sup>	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	280	430	550 <sup>f</sup>	730
		I	1 1/2 16 Gage	170	260	345	440	2 16 Gage	155	235	310	400
	15/32	3/8	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	280	430	550	730	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	280	430	550 <sup>f</sup>	730
		I	1 1/2 16 Gage	185	280	375	475	2 16 Gage	155	235	300	400
	5/16 <sup>c</sup> or 1/4	1 1/2	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	340	510	665 <sup>f</sup>	870	—	—	—	—	—
		1 1/4	6d (2" x 0.113" common, 2" x 0.099" galvanized box)	180	270	350	450	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	180	270	350	450
	3/8	I	1 1/2 16 Gage	145	220	295	375	2 16 Gage	110	165	220	285
		1 1/4	6d (2" x 0.113" common, 2" x 0.099" galvanized box)	200	300	390	510	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	200	300	390	510
7/16	3/8	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	220 <sup>d</sup>	320 <sup>d</sup>	410 <sup>d</sup>	530 <sup>d</sup>	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	260	380	490 <sup>f</sup>	640	
	I	1 1/2 16 Gage	140	210	280	360	2 16 Gage	140	210	280	360	
Sheathing, plywood siding <sup>e, g</sup> except Group 5 Species	7/16	3/8	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	240 <sup>d</sup>	350 <sup>d</sup>	450 <sup>d</sup>	585 <sup>d</sup>	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	260	380	490 <sup>f</sup>	640
		I	1 1/2 16 Gage	155	230	310	395	2 16 Gage	140	210	280	360
15/32	3/8	3/8	8d (2 1/2" x 0.131" common, 2 1/2" x 0.113" galvanized box)	260	380	490	640	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	260	380	490 <sup>f</sup>	640
		1 1/2	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	310	460	600 <sup>f</sup>	770	—	—	—	—	
19/32	3/8	I	1 1/2 16 Gage	170	255	335	430	2 16 Gage	140	210	280	360
		1 1/2	10d (3" x 0.148" common, 3" x 0.128" galvanized box)	340	510	665 <sup>f</sup>	870	—	—	—	—	
5/16 <sup>c</sup>	3/8	I	1 3/4 16 Gage	185	280	375	475	—	—	—	—	—
		1 1/4	Nail Size (galvanized casing)	140	210	275	360	Nail Size (galvanized casing)	140	210	275	360
3/8 <sup>c</sup>	3/8	1 1/4	6d (2" x 0.099")	160	240	310	410	8d (2 1/2" x 0.113")	160	240	310 <sup>f</sup>	410
		1 3/8	8d (2 1/2" x 0.113")	160	240	310	410	10d (3" x 0.128")	160	240	310 <sup>f</sup>	410

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 AF&PA NDS. (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)]<sup>1</sup>, where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
- b. Panel edges backed with 2-inch nominal or wider framing. Install panels either horizontally or vertically. Space fasteners maximum 6 inches on center along intermediate framing members for 3/8-inch and 7/16-inch panels installed on studs spaced 24 inches on center. For other conditions and panel thickness, space fasteners maximum 12 inches on center on intermediate supports.
- c. 3/8-inch panel thickness or siding with a span rating of 16 inches on center is the minimum recommended where applied directly to framing as exterior siding. For grooved panel thickness is the thickness of the panel measured at the point of nailing.

(continued)

**TABLE 2306.3—continued**  
**ALLOWABLE SHEAR (POUNDS PER FOOT) FOR WOOD STRUCTURAL PANEL SHEAR WALLS WITH**  
**FRAMING OF DOUGLAS FIR-LARCH OR SOUTHERN PINE<sup>a</sup> FOR WIND OR SEISMIC LOADING<sup>b, h, i, j, l</sup>**

- d. Allowable shear values 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 on center, or (b) panels are applied with long dimension across studs.
- e. Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails at all panel edges shall be staggered where panel edge nailing is specified at 2 inches on center or less.
- f. Framing at adjoining panel edges shall be 3 inches nominal or wider, and nails at all panel edges shall be staggered where both of the following conditions are met: (1) 10d ( $3'' \times 0.148''$ ) nails having penetration into framing of more than  $1\frac{1}{2}$  inches and (2) panel edge nailing is specified at 3 inches on center or less.
- g. Values apply to all-veneer plywood. Thickness at point of fastening on panel edges governs shear values.
- h. 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 at adjoining panel edges and nails at all panel edges shall be staggered.
- i. Reserved.
- j. Galvanized nails shall be hot dipped or tumbled.
- k. Staples shall have a minimum crown width of  $7/16$  inch and shall be installed with their crowns parallel to the long dimension of the framing members.
- l. For shear loads of normal or permanent load duration as defined by the AF&PA NDS, the values in the table above shall be multiplied by 0.63 or 0.56, respectively.

**TABLE 2306.5**  
**ALLOWABLE SHEAR FOR PARTICLEBOARD SHEAR WALL SHEATHING<sup>b</sup>**

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) <sup>a</sup>			
				6	4	3	2
M-S "Exterior Glue" and M-2 "Exterior Glue"	$3/8$	$1\frac{1}{2}$	6d	120	180	230	300
	$3/8$	$1\frac{1}{2}$	8d	130	190	240	315
	$1/2$			140	210	270	350
	$1/2$	$1\frac{5}{8}$	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. Reserved.
- b. Galvanized nails shall be hot-dipped or tumbled.

**TABLE 2306.6**  
**ALLOWABLE SHEAR VALUES (plf) FOR WIND LOADING ON**  
**SHEAR WALLS OF FIBERBOARD SHEATHING BOARD CONSTRUCTION FOR TYPE V CONSTRUCTION ONLY<sup>a, b, c, d, e</sup>**

THICKNESS AND GRADE	FASTENER SIZE	ALLOWABLE SHEAR VALUE (pounds per linear foot) NAIL SPACING AT PANEL EDGES (inches) <sup>a</sup>		
		4	3	2
$1/2''$ or $25/32''$ Structural	No. 11 gage galvanized roofing nail $1\frac{1}{2}''$ long for $1/2''$ , $1\frac{3}{4}''$ long for $25/32''$ with $3/8''$ head	170	230	260
	No. 11 gage galvanized staple, $7/16''$ crown <sup>f</sup>	150	200	225
	No. 11 gage galvanized staple, 1" crown <sup>f</sup>	220	290	325

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

- a. Fiberboard sheathing 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. For framing of other species: (1) Find specific gravity for species of framing lumber in AF&PA NDS. (2) For staples, multiply the shear value from the table above by 0.82 for species with specific gravity of 0.42 or greater, or 0.65 for all other species. (3) For nails, multiply the shear value from the table above by the following adjustment factor: specific gravity adjustment factor =  $[1 - (0.5 - SG)]$ , where SG = Specific gravity of the framing lumber.
- c. Values shown are for fiberboard sheathing on one side only with long panel dimension either parallel or perpendicular to studs.
- d. Fastener shall be spaced 6 inches on center along intermediate framing members.
- e. Reserved.
- f. Staple length shall not be less than  $1\frac{1}{2}$  inches for  $25/32$ -inch sheathing or  $1\frac{1}{4}$  inches for  $1/2$ -inch sheathing.

**TABLE 2306.7  
ALLOWABLE SHEAR FOR WIND 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 <sup>b</sup> MAXIMUM (inches)	SHEAR VALUE <sup>a, e</sup> (plf)	MINIMUM FASTENER SIZE <sup>c, d, i, k</sup>		
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 No. 16 gage galv. staple, 1/8" legs		
2. Gypsum lath, plain or perforated with vertical joints staggered	3/8" lath and 1/2" plaster	Unblocked	5	180	No. 13 gage galv. 1 1/8" long, 19/64" head, plasterboard nail		
3. Gypsum lath, plain or perforated	3/8" lath and 1/2" plaster	Unblocked	5	100	No. 16 gage galv. staple 1 1/8" long, 0.120" nail min. 3/8" head, 1 1/4" long		
4. 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 <sup>d</sup>	4	175			
		Unblocked	7	100			
4. Gypsum sheathing	5/8" x 4'	Blocked	4" edge/7" field	200	6d galvanized 0.120" Nail, min. 3/8" head, 1 3/4" long		
	5. Gypsum board, gypsum veneer base or water-resistant gypsum backing board	1/2"	Unblocked <sup>f</sup>	7	75	5d cooler (1 5/8" x 0.086") or wallboard 0.120" nail, min. 3/8" head, 1 1/2" long No. 16 gage galv. staple, 1 1/2" long	
			Unblocked <sup>f</sup>	4	110		
Unblocked			7	100			
Unblocked			4	125			
Blocked <sup>g</sup>			7	125			
Blocked <sup>g</sup>			4	150			
Unblocked			8/12 <sup>h</sup>	60			
Blocked <sup>g</sup>			4/16 <sup>h</sup>	160			
Blocked <sup>f, g</sup>			4/12 <sup>h</sup>	155			
Blocked <sup>g</sup>			8/12 <sup>h</sup>	70			
5. Gypsum board, gypsum veneer base or water-resistant gypsum backing board	5/8"	Unblocked <sup>f</sup>	7	115	6d cooler (1 7/8" x 0.092") or wallboard 0.120" nail, min. 3/8" head, 1 3/4" long No. 16 gage galv. staple, 1 1/2" legs, 1 5/8" long		
			4	145			
		Blocked <sup>g</sup>	7	145			
			4	175			
		Blocked <sup>g</sup>	Two-ply	Base ply: 9 Face ply: 7		250	Base ply-6d cooler (1 7/8" x 0.092") or wallboard 1 3/4" x 0.120" nail, min. 3/8" head 1 5/8" 16 gage galv. staple Face ply-8d cooler (2 3/8" x 0.113") or wallboard 0.120" nail, min. 3/8" head, 2 3/8" long No. 15 gage galv. staple, 2 1/4" long
		Unblocked		8/12 <sup>h</sup>		70	No. 6—1 1/4" screws <sup>i</sup>

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

- a. These shear walls shall not be used to resist loads imposed by masonry or concrete walls (see Section 4.1.5 of AF & PA SDPWS). Values shown are for short-term loading due to wind loading. Values shown shall be reduced 25 percent for normal loading.
- b. Applies to fastening at studs, top and bottom plates and blocking.
- c. Alternate fasteners are permitted to be used if their dimensions are not less than the specified dimensions. Drywall screws are permitted to substitute for the 5d (1 5/8" x 0.086"), and 6d (1 7/8" x 0.092") (cooler) nails listed above, and No. 6 1/4 inch Type S or W screws for 6d (1 7/8" x 0.092) (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 on center.
- f. Maximum framing spacing of 24 inches on center.
- g. All edges are blocked, and edge fastening is provided at all supports and all panel edges.
- h. First number denotes fastener spacing at the edges; second number denotes fastener spacing at intermediate framing members.
- i. Screws are Type W or S.
- j. Staples shall have a minimum crown width of 7/16 inch, measured outside the legs, and shall be installed with their crowns parallel to the long dimension of the framing members.
- 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.

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) o.c. in both the longitudinal and transverse directions in each *story*.

**2308.3.2 Braced wall line connections.** Wind lateral forces shall be transferred from the roofs and floors to braced wall lines and from the braced wall lines in upper stories to the braced wall lines in the *story* below in accordance with this section.

Braced wall line top plates shall be fastened to joists, rafters or full-depth blocking above in accordance with Table 2304.9.1, Items 11, 12, 15 or 19 as applicable based on the orientation of the joists or rafters to the braced wall line. Braced wall line bottom plates shall be connected to joists or blocking below in accordance with Table 2304.9.1, Item 6, or to foundations in accordance with Section 2308.3.3. At exterior gable end walls, braced wall panel sheathing in the top *story* shall be extended and fastened to roof framing where the spacing between parallel exterior braced wall lines is greater than 50 feet (15 240 mm).

**Exception:** Where roof trusses are used and are installed perpendicular to an exterior braced wall line, 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 providing equivalent lateral force transfer. Blocking shall be a minimum of 2 inches (51 mm) nominal in thickness and equal to the depth of the truss at the wall line and shall be fastened to the braced wall line top plate as specified in Table 2304.9.1, Item 11.

**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) o.c. for structures over two *stories above grade plane*. 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 a 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 dimension not over 50 feet (15 240 mm), continuous foundations are required at exterior walls only.

**2308.4 Design of elements.** Combining of engineered elements or systems and conventionally specified elements or systems is permitted subject to the following limits:

**2308.4.1 Elements exceeding limitations of conventional construction.** When a building of otherwise conventional construction contains structural elements

exceeding the limits of Section 2308.2, these elements and the supporting load path shall be designed in accordance with accepted engineering practice and the provisions of this code.

**2308.4.2 Structural elements or systems not described herein.** When a building of otherwise conventional construction contains structural elements or systems not described in Section 2308, these elements or systems shall be designed in accordance with accepted engineering practice and the provisions of this code. The extent of such design need only demonstrate compliance of the nonconventional elements with other applicable provisions of this code and shall be compatible with the performance of the conventionally 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-diameter (12.7 mm) steel bolts or *approved* anchors spaced to provide equivalent anchorage as the steel bolts. 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) o.c. 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).

**2308.8.2.1 Engineered wood products.** Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members or I-joists are not permitted except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a *registered design professional*.

**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 the 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 Section 2304.7.1.

**2308.8.7 Under-floor ventilation.** For under-floor ventilation, see Section 1203.3.

## 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) o.c., 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. Studs shall be continuous from a support at the sole plate to a support at the top plate to resist loads perpendicular to the wall. The support shall be a foundation or floor, ceiling or roof diaphragm or shall be designed in accordance with accepted engineering practice.

**Exception:** Jack studs, trimmer studs and cripple studs at openings in walls that comply with Table 2308.9.5.

**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  $\frac{3}{8}$ -inch-thick (9.5 mm) wood structural panel,  $\frac{3}{8}$ -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. Plates shall be a nominal 2 inches (51 mm) in depth and have a width at least equal to the width of the studs.

**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) o.c. and are permitted to be set with the long dimension parallel to the wall. Inte-

TABLE 2308.8(1)  
 FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES  
 (Residential Sleeping Areas, Live Load = 30 pounds per square foot,  $L/\Delta = 360$ )

JOIST SPACING (inches)	DEAD LOAD = 10 psf				DEAD LOAD = 20 psf				
	2 x 6	2 x 8	2 x 10	2 x 12	2 x 6	2 x 8	2 x 10	2 x 12	
	Maximum floor joist spans (ft. - in.)								
SPECIES AND GRADE	(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	24-2	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
16	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
	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
16	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 pounds per square foot, L/Δ = 360)

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

TABLE 2308.8(2)  
 FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES  
 (Residential Living Areas, Live Load = 40 pounds per square foot,  $L/\Delta = 360$ )

JOIST SPACING (Inches)	DEAD LOAD = 10 psf				DEAD LOAD = 20 psf				
	2 x 6	2 x 8	2 x 10	2 x 12	2 x 6	2 x 8	2 x 10	2 x 12	
	Maximum floor joist spans (ft. - in.)								
SPECIES AND GRADE	(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
16	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
	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
16	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 pounds per square foot,  $L/\Delta = 360$ )

JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
		2 x 6	2 x 8	2 x 10	2 x 12	2 x 6	2 x 8	2 x 10	2 x 12
		(ft. - in.)	(ft. - in.)	(ft. - in.)	(ft. - in.)	Maximum floor joist spans (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 <sup>a</sup>
	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/m<sup>2</sup>.  
 a. End bearing length shall be increased to 2 inches.

rior 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 as shown in Figure 2308.9.3, 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 not more than 12 1/2 feet (3810 mm) from each 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-inch by 4-inch (25 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) o.c.
3. Wood structural panel sheathing with a thickness not less than 3/8 inch (9.5 mm) for 16-inch (406 mm) or 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 or horizontally on studs spaced not over 16 inches (406 mm) o.c. where installed with fasteners in accordance with Section 2306.6 and Table 2306.6.

5. Gypsum board [sheathing 1/2-inch-thick (12.7 mm) by 4-foot-wide (1219 mm) wallboard or veneer base] on studs spaced not over 24 inches (610 mm) o.c. and nailed at 7 inches (178 mm) o.c. with nails as required by Table 2306.7.
6. Particleboard wall sheathing panels where installed in accordance with Table 2308.9.3(4).
7. Portland cement plaster on studs spaced 16 inches (406 mm) o.c. installed in accordance with Section 2510.
8. Hardboard panel siding where installed in accordance with Section 2303.1.6 and Table 2308.9.3(5).

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

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

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

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

- 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.
- Shall not be used in exterior walls.

panel shall be sheathed on one face with  $\frac{3}{8}$ -inch-minimum-thickness (9.5 mm) wood structural panel 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).

**2308.9.3.2 Alternate bracing wall panel adjacent to a door or window opening.** Any bracing required by Section 2308.9.3 is permitted to be replaced by the following when used adjacent to a door or window opening with a full-length header:

1. In one-story buildings, each panel shall have a length of not less than 16 inches (406 mm) and a height of not more than 10 feet (3048 mm). Each panel shall be sheathed on one face with a single layer of  $\frac{3}{8}$  inch (9.5 mm) minimum thickness wood structural panel sheathing nailed with 8d common or galvanized box nails in accordance with Figure 2308.9.3.2. The wood structural panel sheathing shall extend up over the solid sawn or glued-laminated header and shall be nailed in accordance with Figure 2308.9.3.2. A built-up header consisting of at least two  $2 \times 12$ s and fastened in accordance with Item 24 of Table 2304.9.1 shall be permitted to be used. A spacer, if used, shall be placed on the side of the built-up beam opposite the wood structural panel sheathing. The header shall extend between the inside

faces of the first full-length outer studs of each panel. The clear span of the header between the inner studs of each panel shall be not less than 6 feet (1829 mm) and not more than 18 feet (5486 mm) in length. A strap with an uplift capacity of not less than 1,000 pounds (4,400 N) shall fasten the header to the inner studs opposite the sheathing. One anchor bolt not less than  $\frac{5}{8}$  inch (15.9 mm) diameter and installed in accordance with Section 2308.6 shall be provided in the center of each sill plate. The studs at each end of the panel shall have a tie-down device fastened to the foundation with an uplift capacity of not less than 4,200 pounds (18 480 N).

Where a panel is located on one side of the opening, the header shall extend between the inside face of the first full-length stud of the panel and the bearing studs at the other end of the opening. A strap with an uplift capacity of not less than 1,000 pounds (4400 N) shall fasten the header to the bearing studs. The bearing studs shall also have a tie-down device fastened to the foundation with an uplift capacity of not less than 1,000 pounds (4400 N).

The tie-down devices shall be an embedded strap type, installed in accordance with the manufacturer's recommendations. The panels shall be 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 not less than 15 inches (381 mm) with the reinforcement required in the continuous foundation located directly under the braced wall line.

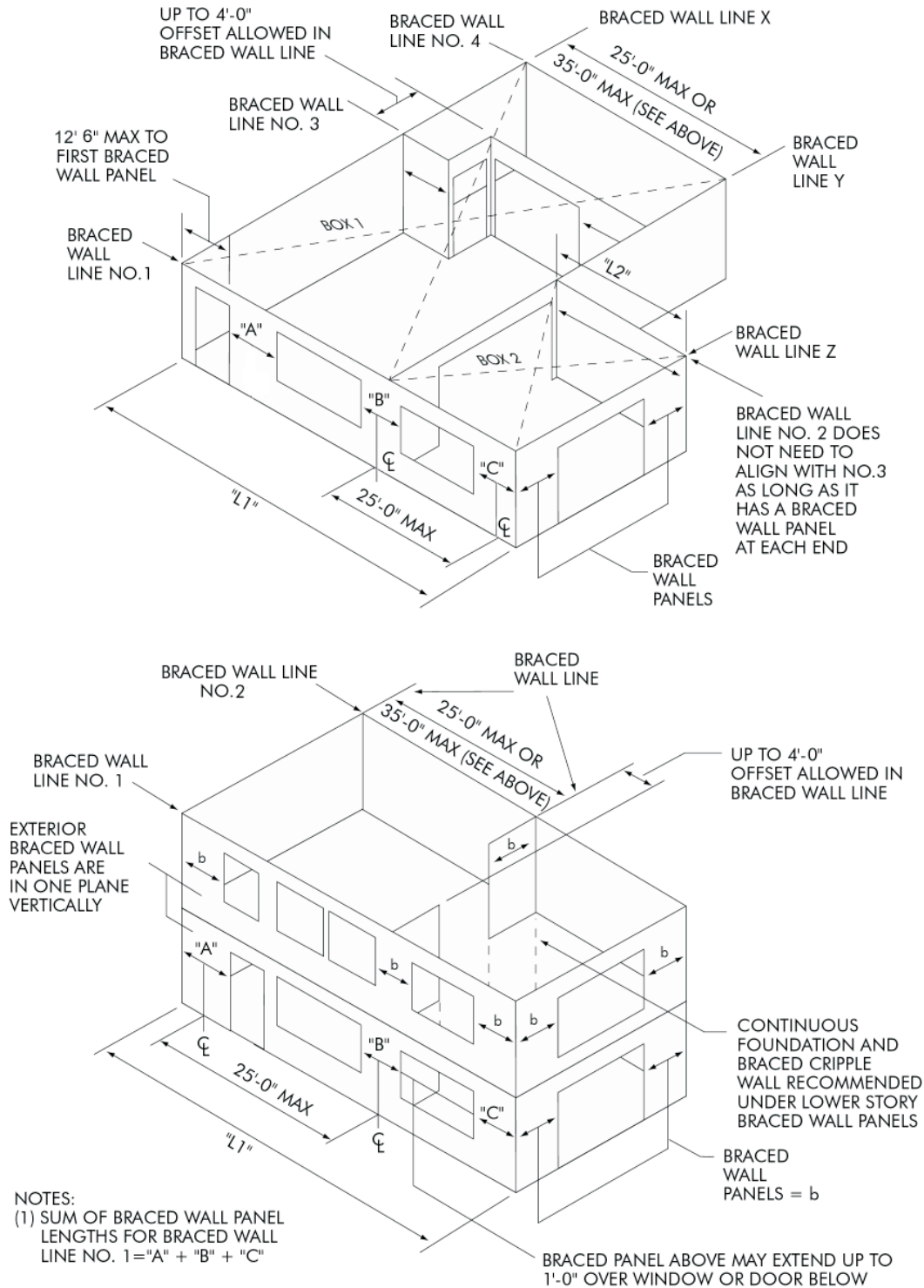
2. In the first *story* of two-story buildings, each wall panel shall be braced in accordance with Item 1 above, except that each panel shall have a length of not less than 24 inches (610 mm).

**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).

**2308.9.4.2 Nailing of bracing.** Spacing of edge nailing for required wall bracing shall not exceed 6 inches (152

MAXIMUM WALL SPACING (feet)	REQUIRED BRACING LENGTH, b
35'-0"	Table 2308.9.3(1) and Section 2308.9.3



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

**FIGURE 2308.9.3**  
**BASIC COMPONENTS OF THE LATERAL BRACING SYSTEM**

**TABLE 2308.9.3(1)  
BRACED WALL PANELS<sup>a</sup>**

CONDITION	CONSTRUCTION METHODS <sup>b, c</sup>								BRACED PANEL LOCATION AND LENGTH <sup>d</sup>
	1	2	3	4	5	6	7	8	
One story, top of two or three story	X	X	X	X	X	X	X	X	Location in accordance with Section 2308.9.3 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 <sup>e</sup>	X	X	X	

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 Sections 2308.9.3.1 and 2308.9.3.2 for alternative braced panel requirements.  
d. Building length is the dimension parallel to the braced wall length.  
e. Reserved.  
f. Reserved.

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

MINIMUM THICKNESS <sup>a</sup> (inch)	MINIMUM NUMBER OF PLYS	STUD SPACING (inches) Plywood siding applied directly to studs or over sheathing
$\frac{3}{8}$	3	16 <sup>b</sup>
$\frac{1}{2}$	4	24

For SI: 1 inch = 25.4 mm.

- a. Thickness of grooved panels is measured at bottom of grooves.  
b. Spans 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)  $\frac{7}{16}$ -inch wood structural panel sheathing or (3)  $\frac{3}{8}$ -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<sup>b</sup>  
(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	Nailable sheathing	
			Sheathing parallel to studs	Sheathing perpendicular to studs
$\frac{3}{8}$ , $\frac{15}{32}$ , $\frac{1}{2}$	16/0, 20/0, 24/0, 32/16 Wall—24" o.c.	24	16	24
$\frac{7}{16}$ , $\frac{15}{32}$ , $\frac{1}{2}$	24/0, 24/16, 32/16 Wall—24" o.c.	24	24 <sup>a</sup>	24

For SI: 1 inch = 25.4 mm.

- a. Plywood shall consist of four or more plies.  
b. Blocking of horizontal joints shall not be required except as specified in Sections 2306.3 and 2308.12.4.

WOOD

**TABLE 2308.9.3(4)**  
**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(5)**  
**HARDBOARD SIDING**

SIDING	MINIMUM NOMINAL THICKNESS (inch)	2 x 4 FRAMING MAXIMUM SPACING	NAIL SIZE <sup>a, b, d</sup>	NAIL SPACING	
				General	Bracing panels <sup>c</sup>
<b>1. Lap siding</b>					
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
<b>2. Square edge panel siding</b>					
Direct to studs	3/8	24" o.c.	6d	6" o.c. edges; 12" o.c. at intermediate supports	4" o.c. edges; 8" o.c. at intermediate supports
Over sheathing	3/8	24" o.c.	8d	6" o.c. edges; 12" o.c. at intermediate supports	4" o.c. edges; 8" o.c. at intermediate supports
<b>3. Shiplap edge panel siding</b>					
Direct to studs	3/8	16" o.c.	6d	6" o.c. edges; 12" o.c. at intermediate supports	4" o.c. edges; 8" o.c. at intermediate supports
Over sheathing	3/8	16" o.c.	8d	6" o.c. edges; 12" o.c. at intermediate supports	4" o.c. edges; 8" o.c. at intermediate 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.

mm) o.c. 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 *dwelling*s. Headers for other buildings shall be designed in accordance with Section 2301.2, Item 1 or 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 1½ inches (38 mm) for the full width of the lintel.

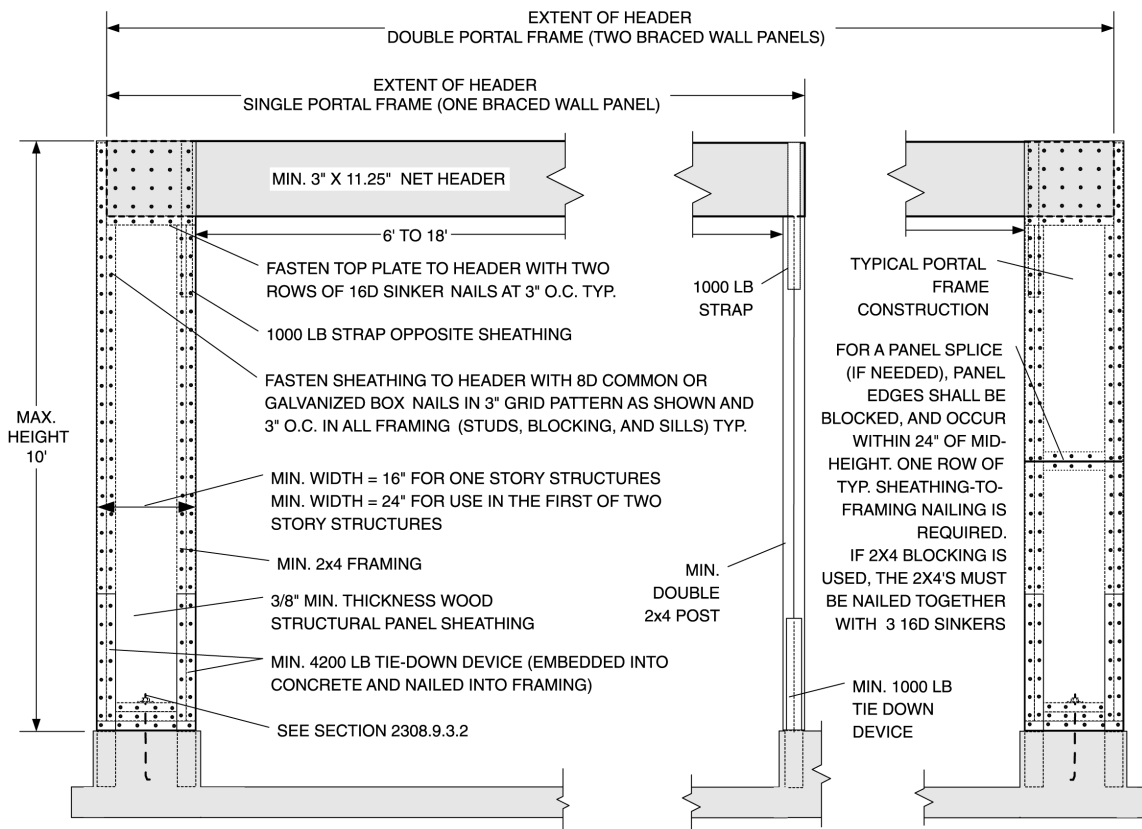
**2308.9.6 Openings in interior bearing partitions.** Headers shall be provided over each opening in interior bearing partitions as required in Section 2308.9.5. The spans in

Table 2308.9.6 are permitted to be used. Wall studs shall support the ends of the header in accordance with Table 2308.9.5 or 2308.9.6, as appropriate.

**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 hav-



For SI: 1 foot = 304.8 mm, 1 inch = 25.4 mm, 1 pound = 4.448 N.

**FIGURE 2308.9.3.2**  
ALTERNATE BRACED WALL PANEL ADJACENT TO A DOOR OR WINDOW OPENING

TABLE 2308.9.5  
 HEADER AND GIRDER SPANS<sup>a</sup> FOR EXTERIOR BEARING WALLS  
 (Maximum Spans for Douglas Fir-Larch, Hem-Fir, Southern Pine and Spruce-Pine-Fir<sup>b</sup> and Required Number of Jack Studs)

	Building width <sup>c</sup> (feet)											
	20				28				36			
	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>
	2-2 x 4	1	3-6	1	3-2	1	2-10	1	2-10	1	1	1
	2-2 x 6	1	5-5	1	4-8	1	4-2	1	4-2	1	1	1
	2-2 x 8	1	6-10	1	5-11	2	5-4	2	5-4	2	2	2
	2-2 x 10	2	8-5	2	7-3	2	6-6	2	6-6	2	2	2
	2-2 x 12	2	9-9	2	8-5	2	7-6	2	7-6	2	2	2
Roof & Ceiling	3-2 x 8	1	8-4	1	7-5	1	6-8	1	6-8	1	1	1
	3-2 x 10	1	10-6	1	9-1	2	8-2	2	8-2	2	2	2
	3-2 x 12	2	12-2	2	10-7	2	9-5	2	9-5	2	2	2
	4-2 x 8	1	9-2	1	8-4	1	7-8	1	7-8	1	1	1
	4-2 x 10	1	11-8	1	10-6	1	9-5	1	9-5	1	2	2
	4-2 x 12	1	14-1	1	12-2	2	10-11	2	10-11	2	2	2
	2-2 x 4	1	3-1	1	2-9	1	2-5	1	2-5	1	1	1
	2-2 x 6	1	4-6	1	4-0	1	3-7	1	3-7	1	2	2
	2-2 x 8	2	5-9	2	5-0	2	4-6	2	4-6	2	2	2
	2-2 x 10	2	7-0	2	6-2	2	5-6	2	5-6	2	2	2
	2-2 x 12	2	8-1	2	7-1	2	6-5	2	6-5	2	2	2
Roof, Ceiling & 1 Center-Bearing Floor	3-2 x 8	1	7-2	1	6-3	2	5-8	2	5-8	2	2	2
	3-2 x 10	2	8-9	2	7-8	2	6-11	2	6-11	2	2	2
	3-2 x 12	2	10-2	2	8-11	2	8-0	2	8-0	2	2	2
	4-2 x 8	1	8-1	1	7-3	1	6-7	1	6-7	1	1	1
	4-2 x 10	1	10-1	1	8-10	2	8-0	2	8-0	2	2	2
	4-2 x 12	2	11-9	2	10-3	2	9-3	2	9-3	2	2	2
	2-2 x 4	1	2-8	1	2-4	1	2-1	1	2-1	1	1	1
	2-2 x 6	1	3-11	1	3-5	2	3-0	2	3-0	2	2	2
	2-2 x 8	2	5-0	2	4-4	2	3-10	2	3-10	2	2	2
	2-2 x 10	2	6-1	2	5-3	2	4-8	2	4-8	2	2	2
	2-2 x 12	2	7-1	2	6-1	3	5-5	3	5-5	3	3	3
Roof, Ceiling & 1 Clear Span Floor	3-2 x 8	2	6-3	2	5-5	2	4-10	2	4-10	2	2	2
	3-2 x 10	2	7-7	2	6-7	2	5-11	2	5-11	2	2	2
	3-2 x 12	2	8-10	2	7-8	2	6-10	2	6-10	2	2	2
	4-2 x 8	1	7-2	1	6-3	2	5-7	2	5-7	2	2	2
	4-2 x 10	2	8-9	2	7-7	2	6-10	2	6-10	2	2	2
	4-2 x 12	2	10-2	2	8-10	2	7-11	2	7-11	2	2	2

(continued)



TABLE 2308.9.5—continued  
 HEADER AND GIRDER SPANS<sup>a</sup> FOR EXTERIOR BEARING WALLS  
 (Maximum Spans for Douglas Fir-Larch, Hem-Fir, Southern Pine and Spruce-Pine-Fir<sup>b</sup> and Required Number of Jack Studs)

	Building width <sup>c</sup> (feet)					
	20		28		36	
	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>
Roof, Ceiling & 2 Center-Bearing Floors	2-2 x 4	1	2-3	1	2-0	1
	2-2 x 6	2	3-3	2	2-11	2
	2-2 x 8	2	4-2	2	3-9	2
	2-2 x 10	2	5-1	2	4-7	3
	2-2 x 12	2	5-10	3	5-3	3
	3-2 x 8	2	5-2	2	4-8	2
	3-2 x 10	2	6-4	2	5-8	2
	3-2 x 12	2	7-4	2	6-7	2
	4-2 x 8	1	6-0	2	5-5	2
	4-2 x 10	2	7-4	2	6-7	2
	4-2 x 12	2	8-6	2	7-8	2
	2-2 x 4	1	1-8	1	1-6	2
Roof, Ceiling & 2 Clear Span Floors	2-2 x 6	2	2-8	2	2-4	2
	2-2 x 8	2	3-4	2	3-0	3
	2-2 x 10	2	4-1	3	3-8	3
	2-2 x 12	3	4-9	3	4-3	3
	3-2 x 8	2	4-2	2	3-9	2
	3-2 x 10	2	5-1	2	4-7	3
	3-2 x 12	2	5-11	3	5-4	3
	4-2 x 8	2	4-10	2	4-4	2
	4-2 x 10	2	5-11	2	5-3	2
	4-2 x 12	2	6-10	2	6-2	3

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m<sup>2</sup>.

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

b. Tabulated values are for No. 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 one, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.

e. Reserved.

**TABLE 2308.9.6**  
**HEADER AND GIRDER SPANS<sup>a</sup> FOR INTERIOR BEARING WALLS**  
 (Maximum Spans for Douglas Fir-Larch, Hem-Fir, Southern Pine and Spruce-Pine-Fir<sup>b</sup> and Required Number of Jack Studs)

HEADERS AND GIRDERS SUPPORTING	SIZE	BUILDING WIDTH <sup>c</sup> (feet)					
		20		28		36	
		Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>	Span	NJ <sup>d</sup>
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	9-0	1	7-8	1	6-9	1
	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	6-1	1	5-3	2	4-8	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 No. 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 one, the headers are permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.

ing 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  $\frac{5}{8}$  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.** The roof construction 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 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 species, refer to the *AF&PA Span Tables for Joists and Rafters*.

**Table 2308.10.3(3) Rafter Spans for Common Lumber Species (Ground Snow Load = 30 pounds per square foot, Ceiling Not Attached to Rafters,  $L/\Delta = 180$ ).** Reserved.

**Table 2308.10.3(4) Rafter Spans for Common Lumber Species. (Ground Snow Load = 50 pounds per square foot, Ceiling Not Attached to Rafters,  $L/\Delta = 180$ ).** Reserved.

**Table 2308.10.3(5) Rafter Spans for Common Lumber Species (Ground Snow Load = 30 pounds per square foot, Ceiling Attached to Rafters,  $L/\Delta = 240$ ).** Reserved.

**Table 2308.10.3(6) Rafter Spans for Common Lumber Species. (Ground Snow Load = 50 pounds per square foot, Ceiling Attached to Rafters,  $L/\Delta = 240$ ).** Reserved.

**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.** Ceiling 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  $1\frac{1}{2}$  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) o.c. 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) o.c. 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) o.c., the number of 16d common nails shall be two times the number specified for rafters spaced 16 inches (406 mm) o.c., with a minimum of four 16d common nails where no snow loads are indicated. Where rafter ties are spaced at 48 inches (1219 mm) o.c., the number of 16d common nails shall be two times the number specified for rafters spaced 24 inches (610 mm) o.c., with a minimum of six 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.

**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

**TABLE 2308.10.1**  
**REQUIRED RATING OF APPROVED UPLIFT CONNECTORS (pounds)<sup>a, b, c, e, f, g, h</sup>**

$V_{asd}$ AS DETERMINED IN ACCORDANCE WITH SECTION 1609.3.1	ROOF SPAN (feet)							OVERHANGS (pounds/feet) <sup>d</sup>
	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 per 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 below.

EXPOSURE	Mean Roof Height (feet)									
	15	20	25	30	35	40	45	50	55	60
B	1.00	1.00	1.00	1.00	1.05	1.09	1.12	1.16	1.19	1.22
C	1.21	1.29	1.35	1.40	1.45	1.49	1.53	1.56	1.59	1.62
D	1.47	1.55	1.61	1.66	1.70	1.74	1.78	1.81	1.84	1.87

- 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 Figure 28.6.3 of ASCE 7. 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).
- g. Interpolation is permitted for intermediate values or  $V_{asd}$  and roof spans.
- h. The rated capacity of approved tie-down devices is permitted to include up to a 60-percent increase for wind effects where allowed by material specifications.

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 Engineered wood products.** Prefabricated wood I-joists, structural glued-laminated timber and structural composite lumber shall not be notched or drilled except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a *registered design professional*.

**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 sup-

TABLE 2308.10.2(1)  
 CEILING JOIST SPANS FOR COMMON LUMBER SPECIES  
 (Uninhabitable Attics Without Storage, Live Load = 10 pounds per square foot,  $L/\Delta = 240$ )

CEILING JOIST SPACING (Inches)	SPECIES AND GRADE	DEAD LOAD = 5 psf				
		2 x 4	2 x 6	2 x 8	2 x 10	
		(ft. - in.)	(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 per square foot,  $L/\Delta = 240$ )

CEILING JOIST SPACING (inches)	SPECIES AND GRADE	DEAD LOAD = 5 psf				
		2 x 4 (ft. - in.)	2 x 6 (ft. - in.)	2 x 8 (ft. - in.)	2 x 10 (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/m<sup>2</sup>.  
 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 psf			
		2 x 4 (ft. - in.)	2 x 6 (ft. - in.)	2 x 8 (ft. - in.)	2 x 10 (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 psf				
		2 x 4 (ft. - in.)	2 x 6 (ft. - in.)	2 x 8 (ft. - in.)	2 x 10 (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/m<sup>2</sup>.

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/Δ = 180)

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

(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 psf					DEAD LOAD = 20 pounds psf					
		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	
		(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/m<sup>2</sup>.

a. Span exceeds 26 feet in length. Check sources for availability of lumber in lengths greater than 20 feet.

**TABLE 2308.10.4.1  
RAFTER TIE CONNECTIONS<sup>g</sup>**

RAFTER SLOPE	TIE SPACING (inches)	ROOF SPAN (feet)			
		12	20	28	36
		Required number of 16d common (3 <sup>1</sup> / <sub>2</sub> " x 0.162") nails <sup>a, b</sup> per connection <sup>c, d, e, f</sup>			
3:12	12	4	6	8	10
	16	5	7	10	13
	24	7	11	15	19
	32	10	14	19	25
	48	14	21	29	37
4:12	12	3	4	5	6
	16	3	5	7	8
	24	4	7	10	12
	32	6	9	13	16
	48	8	14	19	24
5:12	12	3	3	4	5
	16	3	4	5	7
	24	4	6	8	10
	32	5	8	10	13
	48	7	11	15	20
7:12	12	3	3	3	4
	16	3	3	4	5
	24	3	4	6	7
	32	4	6	8	10
	48	5	8	11	14
9:12	12	3	3	3	3
	16	3	3	3	4
	24	3	3	5	6
	32	3	4	6	8
	48	4	6	9	11
12:12	12	3	3	3	3
	16	3	3	3	3
	24	3	3	3	4
	32	3	3	4	5
	48	3	4	6	7

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.8 N/m<sup>2</sup>.

a. 40d box (5" x 0.162") or 16d sinker (3<sup>1</sup>/<sub>4</sub>" x 0.148") nails are permitted to be substituted for 16d common (3<sup>1</sup>/<sub>2</sub>" x 0.162") 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. Reserved.

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

<b>SPAN<sup>a</sup> (feet)</b>	<b>LIVE LOAD (pound per square foot)</b>	<b>DEFLECTION LIMIT</b>	<b>BENDING STRESS (f) (pound per square inch)</b>	<b>MODULUS OF ELASTICITY (E) (pound per square inch)</b>
<b>Roofs</b>				
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

(continued)

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

SPAN <sup>a</sup> (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)
<b>Roofs</b>				
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
7.5	20	1/240 1/360	560	1,125,000 1,685,000
	30	1/240 1/360	750	1,685,000 2,530,000
	40	1/240 1/360	930	2,250,000 3,380,000
8.0	20	1/240 1/360	640	1,360,000 2,040,000
	30	1/240 1/360	850	2,040,000 3,060,000
<b>Floors</b>				
4 4.5 5.0	40	1/360	840 950 1,060	1,000,000 1,300,000 1,600,000

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kN/m<sup>2</sup>, 1 pound per square inch = 0.00689 N/mm<sup>2</sup>.

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 layup is permitted in accordance with the provisions of Section 2308.10.9. Lumber thickness is 1½ inches nominal.

port, and joints are separated by at least 24 inches (610 mm) in adjacent pieces.

**2308.10.10 Wood trusses.** Wood trusses shall be designed in accordance with Section 2303.4.

**2308.10.11 Attic ventilation.** For *attic* ventilation, see Section 1203.2.

**2308.11 Additional requirements for conventional construction in Seismic Design Category B or C.** Reserved.

**2308.11.1 Number of stories.** Reserved.

**2308.11.2 Concrete or masonry.** Reserved.

**2308.11.3 Framing and connection details.** Reserved.

**2308.11.3.1 Anchorage.** Reserved.

**2308.11.3.2 Stepped footings.** Reserved.

**2308.11.3.3 Openings in horizontal diaphragms.** Reserved.

**2308.12 Additional requirements for conventional construction in Seismic Design Category D or E.** Reserved.

**2308.12.1 Number of stories.** Reserved.

**2308.12.2 Concrete or masonry.** Reserved.

**2308.12.3 Braced wall line spacing.** Reserved.

**2308.12.4 Braced wall line sheathing.** Reserved.

**Table 2308.12.4.** Reserved.

**2308.12.5 Attachment of sheathing.** Reserved.

**2308.12.6 Irregular structures.** Reserved.

**2308.12.7 Anchorage of exterior means of egress components.** Reserved.

**2308.12.8 Sill plate anchorage.** Reserved.

**2308.12.9 Sill plate anchorage in Seismic Design Category E.** Reserved.

## SECTIONS 2309-2313 RESERVED

### SECTION 2314 HIGH-VELOCITY HURRICANE ZONES

**2314.1 Design.** Wood members and their fastenings shall be designed to comply with this code by methods based on rational analysis or approved laboratory testing procedures, both performed in accordance with fundamental principles of theoretical and applied mechanics.

**2314.2 Workmanship.** Wood members shall be framed, anchored, tied and braced to develop the strength and rigidity necessary for the purposes for which they are used and to resist the loads imposed as set forth in this code. Wood construction

shall be in conformance with the tolerances, quality and methods of construction as prescribed by the standards in Chapter 35 of this code.

### 2314.3 Fabrication.

**2314.3.1** Preparation, fabrication and installation of wood members and the glues, connectors and mechanical devices for fastening shall conform to good engineering practice.

**2314.3.2** Any person desiring to manufacture or fabricate wood truss assemblies shall obtain a certificate of competency from the authority having jurisdiction.

**2314.4** The following standards, as set forth in Chapter 35 of this code, are hereby adopted for the design and quality of wood members and their fastenings:

**2314.4.1** American Hardboard Products Association 887-B Wilmette Road, Palatine, IL 60067 AHA

1. Basic Hardboard ANSI/AHA A135.4–1982.
2. Prefinished Hardboard Paneling ANSI/AHA A135.5—1982.
3. Hardboard Siding ANSI/AHA A135.6–1990.
4. Cellulosic Fiberboard ANSI/AHA A194.1–1985.
5. Recommended Product and Application Specification - Structural Insulating Roof Deck, I.B. Spec. No. 1.
6. Recommended Product and Application Specification - 1/2 inch Fiberboard Nail-Base-Sheathing I.B. Spec. No. 2.
7. Recommended Product and Application Specification - 1/2 inch Intermediate Fiberboard Sheathing I.B. Spec. No. 3.

**2314.4.2** American Institute of Timber Construction 333 West Hampden Avenue, Englewood, CO 80110 AITC

1. Typical Construction Details, AITC 104.
2. Code of Suggested Practices, AITC 106.
3. Standard for Heavy Timber Construction, AITC 108.
4. Standard for Preservative Treatment for Structural Glued Laminated Timber, AITC 109.
5. Standard Appearance Grades for Structural Glued Laminated Timber, AITC 110.
6. Standard for Tongue and Groove Heavy Timber Roof Decking, AITC 112.
7. Standard for Dimensions of Glued Laminated Structural Members, AITC 113.
8. Standard Specifications for Structural Glued Laminated Timber of Softwood Species, AITC 117.
9. Standard Specifications for Hardwood Glued Laminated Timber, AITC 119.
10. Technical Report No. 7, Calculation of Fire Resistance of Glued Laminated Timber.
11. Structural Glued Laminated Timber, ANSI/AITC A190.1.

**2314.4.3** APA The Engineered Wood Association (Formerly APA American Plywood Association), P.O. Box 11700, Tacoma, WA 98411

1. APA Design Construction Guide, Residential and Commercial E30D
2. Plywood Design Specification Y510J
3. Plywood Design Specification—Design and Fabrication of Plywood Beams Supplement No. 1 S811
4. Plywood Design Specification—Design and Fabrication of Plywood Beams Supplement No. 2 S812
5. Plywood Design Specification—Design and Fabrication of Plywood Stressed-Skin Panels Supplement No. 3 U813
6. Plywood Design Specifications—Design and Fabrication of Plywood Sandwich Panels Supplement No. 4 U814
7. Plywood Design Specifications—Design and Fabrication of All-Plywood Beams. Supplement No. 5 H815
8. Plywood Folded Plate, Laboratory Report 21 V910
9. APA Design/Construction Guide Diaphragms L350
10. Performance Standards and Policies for Structural-Use Panels PRP-108
11. 303 Siding Manufacturing Specifications B840

**2314.4.4** American Society for Testing Materials, 1916 Race Street, Philadelphia, PA 19103-1187 ASTM

1. Standard Test Methods for Mechanical Fasteners in Wood D 1761
2. Accelerated Weathering on Fire-Retardant Treated Wood for Fire Testing D 2898
3. Surface Burning Characteristics of Building Materials E 84
4. Hygroscopic Properties of Fire-Retardant Wood and Wood-Base Products D 3201
5. Standard Specifications for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems D 3498

**2314.4.5** American Wood Preservers Association P.O. Box 361784, Birmingham, AL 35236-1784 AWPA 2314.4.5

1. AWPA Use Category System Standard—UI.
2. AWPA Standard M4 Care of Pressure Treated Wood Products.

**2314.4.6** National Institute for Standards and Technology Standard Development Services Section, Standards Application and Analysis Division, Washington, D.C. 20234 NIST

1. Mat-Formed Particleboard CS236
2. Structural Glued Laminated Timber PS56
3. Construction and Industrial Plywood PS1
4. American Softwood Lumber Standard PS20



5. Performance Standard for Wood Based Structural Use Panels PS2{\*}

{\*} All wood-based structural panels except plywood shall have Product Approval and shall be tested in accordance with High-Velocity Hurricane Zone Testing Protocols.

**2314.4.7** American Forest and Paper Association, 1111 19 Street NW, Washington, D.C. 20036

1. ANSI/AF&PA National Design Specification for Wood Construction, 2005
2. ANSI/AF&PA Design Values for Wood Construction, 2005
3. Wood Structural Design Data, 1992
4. Span Tables for Joists and Rafters, 2005
5. Design Values for Joists and Rafters, 2005
6. Wood Construction Data No. 1, Details for Conventional Wood Frame Construction, 2001
7. Wood Construction Data No. 4, Plank-and-Beam Framing for Residential Building, 2003
8. Wood Construction Data No. 5, Heavy Timber Construction Details, 2004
9. Wood Construction Data No. 6, Design of Wood Frame Structures for Permanence, 2006
10. ANSI/AF & PA PWF20—07, Permanent Wood Foundation (PWF) Design Specification, 2007
11. ANSI/AF&PA WFCM—2001, Wood Frame Construction Manual for One and Two-family Dwellings, 2001
12. ANSI/AF&PA SDPW2—008 Special Design Provisions for Wind and Seismic, 2008

**2314.4.8** Timber Company, Inc., 2402 Daniels Street, Madison, WI 53704

1. TECO Performance Standards and Policies for Structural use Panels. PRP-133

**2314.4.9** Truss Plate Institute, 218 N. Lee Street, Suite 312, Alexandria, VA 22314

1. *National Design Standard for Metal Plate Connected Wood Truss Construction* (Excluding Chapter 2).
2. Building Component Safety Information (BCSI 1) *Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses* [A joint publication with the Wood Truss Council of America (WTCA)].

**2314.4.10** Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062

1. *Test Methods for Fire Resistance of UL-790 Roof Covering Materials*

## SECTION 2315

### HIGH-VELOCITY HURRICANE ZONES—QUALITY

**2315.1 Identification.** All lumber used structurally, including end-jointed lumber, shall be identified by the grade mark of a lumber grading or inspection bureau or agency approved by the Board of Review of the American Lumber Standards Committee or the Canadian Lumber Standards Administrative Board: except that pre-cut material, rough-sawn lumber and lumber thicker than 2 inches (51 mm) may be covered by a certificate of inspection in lieu of grade marking. The glued joints in end-jointed lumber, when used for load supporting purposes, shall be certified to be in accordance with the appropriate grading rules.

**2315.1.1** Structural glued-laminated timber shall be manufactured and identified as required in ANSI/AITC 190.1 as adopted in Section 2314.4.

**2315.1.2** All wood-based structural panels used structurally, including siding, roof sheathing, wall sheathing, floor sheathing, diaphragms and built-up members, shall be identified for grade and exposure level by the grade stamp of an approved testing and grading agency indicating conformance with PS-1, PS-2, APA PRP-108 or TECO PRP-133 as adopted in Section 2314.4.

**2315.1.3** Wood shingles and/or shakes shall be identified by the grademark of an approved grading or inspection bureau or agency.

**2315.1.4** Fiberboard for its various uses shall conform to ANSI/AHA A 194.1.

**2315.1.5** Hardboard shall conform to AHA Standards as adopted in Section 2314.4, and shall be identified as to classification.

**2315.1.6** Particleboard shall conform to the *Mat-Formed Particleboard Standard*, NIST CS Section 236, as adopted in Section 2314.4.6, and shall be identified by the grade mark or certificate of inspection issued by an approved agency.

**2315.1.7** All lumber and wood-based structural panels required to be fire retardant treated shall bear permanent identification showing the fire performance rating thereof issued by an approved testing agency having a follow-up service. When exposed to the weather, the material shall be permanently identified as suitable for such use in accordance with Section 2327.4. When exposed to sustained high humidity, the material shall be permanently identified as a low hygroscopic type suitable for interior use. Allowable design values, including connection design values, for lumber, glued laminated timber and wood-based structural panels, pressure treated with fire retardant chemicals shall be obtained from the company providing the treatment and redrying services. Listing of allowable design values shall be submitted and approved by the certification agency.

**2315.1.8** All lumber, sawn timber, wood-based structural panels and poles supporting permanent structures and required by this code to be pressure treated and as described in the AWPA standards shall bear the quality mark of an approved inspection agency which maintains continued supervision, testing and inspection over the product. Agen-

cies shall be accredited in accordance with the procedures of the American Lumber Standard (PS 20) or approved equivalent.

**2315.1.9** Pressure-treated poles shall be treated in accordance with AWWA U1 for sawn timber posts (Commodity Specification A, Use Category 4B) and for round timber posts (Commodity Specification B, Use Category 4B).

**2315.1.10** The quality mark shall contain, as a minimum, the following information:

1. The treating company and plant location.
2. The AWWA standard to which the product is treated.
3. The trademark of an approved inspection agency which maintains continued supervision, testing and inspection over the quality of the product as described in the AWWA standards.
4. The preservative used.
5. The amount of retention of the chemical per cubic foot of wood.
6. If applicable, the method of drying after treatment.
7. The purpose for which the wood has been treated: ground contact, above ground or foundation.

**Exception:** When the size of individual pieces, (e.g. lumber less than 1 inch (25 mm) in nominal thickness, or lumber less than nominal 1inch by 5 inches (25 mm by 127 mm) or 2 inches by 4 inches (25 mm by 127 mm), or lumber 36 inches (914 mm) and shorter, except that  $\frac{5}{4}$  by 4 shall be quality marked), prevents application of full legible marks, the quality mark shall be applied by stamping the faces of exterior pieces or by end labeling not less than 2 percent of the pieces of a bundled unit.

**2315.1.11** All wood-based structural panels, including those made of fiberboard, hardboard and particleboard shall have Product Approval. Product Approval shall be given upon certification by an approved independent testing laboratory that the product:

1. Complies with the applicable standards set forth above.
2. The product complies with the manufacturer's published design properties before and after a wet-dry, wet-dry cycle.
3. The product when tested dry maintains a safety factor of 2:1 and when tested after the cycles specified in Section 2315.1.11(2) above maintains a safety factor of 1.5:1. Testing shall be as specified in the testing protocol.

**2315.2** Wood-based structural panels permanently exposed in outdoor locations shall be rated for exterior use. When used for roof sheathing exposed to the outdoors on the underside or used structurally for wall, floor or roof cladding or for diaphragms, the panels shall be rated for Exposure 1 or exterior use.

**2315.3** All lumber 2 inches (51 mm) or less in thickness shall contain not more than 19 percent moisture at the time of perma-

nent incorporation in a building or structure and/or at the time of treatment with a wood preservative.

#### 2315.4 Grade and species.

**2315.4.1** All structural wood members not limited by other sections of this chapter shall be of sufficient size and capacity to carry all loads as required by the high-velocity hurricane provisions of Chapter 16 without exceeding the allowable design stresses specified in the *National Design Specification for Wood Construction* and in compliance with Section 2317.

**2315.4.2** Lumber boards used for floor and roof sheathing shall be in accordance with Table 2315.4.2

**TABLE 2315.4.2  
MINIMUM GRADE REQUIREMENTS: BOARD GRADES**

FLOOR OR ROOF SHEATHING	GRADING RULES
Utility	NLGA, WCLIB or WWPA
No. 4 Common or Utility	NLGA, WCLIB, WWPA, NHPMA or NELMA
No. 3	SPIB
Merchantable	RIS

### SECTION 2316 HIGH-VELOCITY HURRICANE ZONES— SIZES

**2316.1** Sizes of lumber, structural glued-laminated timber and plywood and other wood-based structural panels referred to in this code are nominal sizes.

**2316.2** Computations to determine the required sizes of members shall be based on net dimensions (actual sizes).

### SECTION 2317 HIGH-VELOCITY HURRICANE ZONES— UNIT STRESSES

#### 2317.1 General.

**2317.1.1** Lumber used for joists, rafters, trusses, columns, beams and/or other structural members shall be of no less strength than No. 2 grade of Southern Pine, Douglas Fir-Larch, Hem-Fir or Spruce-Pine-Fir. Joists and rafters shall be sized according to AF&PA Span Tables for Joists and Rafters adopted in Section 2314.4.

**2317.1.2** Lumber used for studs in exterior walls and interior bearing walls shall be of no less strength than stud grade of Southern Pine, Douglas Fir-Larch, Hem-Fir or Spruce-Pine-Fir and capable of resisting all loads determined in accordance with Chapter 16 (High-Velocity Hurricane Zones). The unbraced height of the wall shall be no more than 8 feet 6 inches (2.6 m) (including top and bottom plates). Heights may be increased where justified by rational analysis prepared by a registered professional engineer or registered architect proficient in structural design.

**2317.1.3** Lumber used for studs in interior non-bearing walls shall have a modulus of elasticity of no less than  $0.9 \times 10^6$  pounds per square inch.

**2317.1.4** The designer shall specify on the design drawings the size, spacing, species and grade of all load supporting members.

**2317.2** Allowable stress design value may be modified for repetitive, duration, etc., factors where design is by a registered professional engineer or registered architect proficient in structural design or where such modified values are reflected in the tables of the standards in Section 2314.4.

## SECTION 2318 HIGH-VELOCITY HURRICANE ZONES— VERTICAL FRAMING

**2318.1 Studs in bearing and exterior walls.** Studs in walls framing over 8 feet 6 inches (2.6 m) (including top and bottom plates) or supporting floor and roof loads shall be designed by rational analysis prepared by a registered professional engineer or registered architect proficient in structural design.

**2318.1.1 Minimum size.** Studs shall be not less than 2 inch by 6 inch for exterior walls or 2 inch by 4 inch (51 mm by 102 mm) for interior bearing or load resisting walls unless designed by rational analysis by a registered professional engineer or registered architect proficient in structural design.

**2318.1.2 Spacing.** Studs shall be spaced not more than 16 inches (406 mm) on center unless designed by rational analysis as a system of columns and beams by a registered professional engineer or registered architect proficient in structural design.

### **2318.1.3 Placing.**

**2318.1.3.1** Studs in exterior and bearing walls shall be placed with the longer dimension perpendicular to the wall.

**2318.1.3.2** Studs in exterior walls and in bearing walls shall be supported by foundation plates, sills, or girders or floor framing directly over supporting walls or girders. Stud bearing walls when perpendicular to supporting joists may be offset from supporting walls or girders not more than the depth of the joists unless such joists are designed for the extra loading conditions.

**2318.1.3.3** Stud walls framing into base plates of exterior walls and interior bearing walls resting on masonry or concrete shall be anchored past the plate to the masonry or concrete, or shall be anchored to a sill plate which is anchored in accordance with Section 2318.1.4.1 when the net wind uplift is up to 500 pounds per foot (7297 N/m).

### **2318.1.4 Sills and/or base plates.**

**2318.1.4.1** Sills and/or base plates, where provided in contact with masonry or concrete, shall be of an approved durable species or be treated with an approved preservative and shall be attached to the masonry or concrete with  $\frac{1}{2}$  inch (13 mm) diameter bolts with oversized washer spaced not over 2 feet (610 mm) apart and embedded not less than 7 inches (178 mm) into a grout filled cell of masonry or into concrete. Base plates shall

be placed in a recess  $\frac{3}{4}$  inch (19 mm) deep and the width of the base plate at the edge of a concrete slab, beam/slab or any other type of construction which uses a masonry surface or concrete slab, or be provided with an alternate waterstop method as approved by the building official. Alternate methods of anchorage may be designed by rational analysis by a registered professional engineer or a registered architect proficient in structural design.

**2318.1.4.2** Where the base plate of a bearing wall is supported on joists or trusses running perpendicular to the wall and the studs from the wall above do not fall directly over a joist or truss, a double base plate or a single base plate supported by a minimum 2 inch by 4 inch (51 mm by 102 mm) inset ribbon shall be used to support the upper stud wall.

### **2318.1.5 Top plates.**

**2318.1.5.1** The top plate of stud bearing walls shall be doubled and lapped at each intersection of walls and partitions.

**2318.1.5.2** Joints shall be lapped not less than 4 feet (1219 mm).

**2318.1.6 Corners.** Corners of stud walls and partitions shall be framed solid by not less than three studs.

**2318.1.7 Splicing.** Studs, other than end-jointed lumber, shall be spliced only at points where lateral support is provided.

### **2318.1.8 Framing types.**

**2318.1.8.1** Wood framing may be any one, or a combination of, the following types: platform, balloon, plank and beam or pole type.

**2318.1.8.2** Exterior stud walls of two-story buildings shall be balloon-framed with studs continuous from foundation to second floor ceiling and with second floor joists supported as indicated in Section 2319.3.3. Gable end walls in wood frame buildings shall be balloon framed with studs continuous from foundation to roof.

**Exception:** Platform framing is allowed in buildings over one story in height provided an additional mandatory inspection for floor level connectors is made before the framing/firestopping inspection. Gable end walls shall be balloon framed with studs continuous from top floor to roof.

### **2318.1.9 Notching.**

**2318.1.9.1** Studs that carry loads in excess of 75 percent of their capacity shall not be notched or cut.

**2318.1.9.2** Studs that carry loads 75 percent or less of their capacity may be notched to one-third of the depth without limit of the number of consecutive studs.

### **2318.1.10 Pipes in walls.**

**2318.1.10.1** Stud walls and partitions containing pipes shall be framed to give proper clearance for the piping.

**2318.1.10.2** Where walls and partitions containing piping are parallel to floor joists, the joists shall be doubled and may be spaced to allow vertical passage of pipes.

**2318.1.10.3** Where vertical pipe positions necessitate the cutting of plates, a metal tie not less than 1 inch by  $\frac{1}{8}$  inch (25 mm by 3 mm) shall be placed on each side of the plate across the opening and nailed with not less than two 16d or three 8d nails at each end.

#### **2318.1.11 Headers.**

**2318.1.11.1** All headers in bearing walls shall be designed by rational analysis.

**2318.1.11.2** Headers or lintels over stud wall openings shall have not less than nominal 2-inch (51 mm) bearings.

**2318.1.12** Studs joining masonry or reinforced concrete walls. Where stud walls or partitions join masonry or concrete walls, such studs shall be secured against lateral movement by bolting to the masonry or concrete with  $\frac{1}{2}$  inch (13 mm) diameter anchor bolts with oversized washer spaced not more than 4 feet (1219 mm) apart and embedded not less than 5 inches (127 mm) into a grout filled cell or into concrete or as designed by a registered professional engineer or registered architect proficient in structural design using rational analysis.

**2318.1.13 Wind bracing.** Exterior stud walls shall be effectively wind-braced in accordance with Section 2322.3. Such bracing shall be designed by a registered professional engineer or registered architect proficient in structural design.

**2318.1.14** The intermixing of wall framing described in this chapter with other types of structural wall systems as provided in this code shall not be permitted unless such wall framing and connections are designed by a registered professional engineer or registered architect proficient in structural design.

**2318.1.15 Wall hung fixtures.** Studs in bearing walls, exterior walls and nonbearing partitions supporting wall hung plumbing fixtures and wall cabinets shall be not less than  $2 \times 4$ , where spaced not more than 16 inches (406 mm) on center or, not less than 2 inch by 6 inch (51 mm by 152 mm), where spaced not more than 24 inches (610 mm) on center.

**2318.1.15.1** A minimum 2-inch by 4-inch (51 mm by 104 mm) horizontal wood member, securely fastened to not less than two such studs, shall be installed for the attachment of each wall hung plumbing fixture and wall cabinet.

#### **2318.2 Interior nonbearing partitions.**

**2318.2.1** Studs in interior nonbearing partitions shall be of not less than 2 inch by 4 inch (51 mm by 104 mm) spaced not more than 24 inches (610 mm) o.c.

**2318.2.2** Interior nonbearing stud partitions may have a single top plate.

**2318.2.3** Headers over openings not exceeding 4 feet (1219 mm) in width may be of 2-inch (51 mm) nominal thickness placed flat and end-nailed through the studs with no solid bearing provided.

**2318.2.4** Studs in interior nonbearing partitions shall be placed with the longer dimension perpendicular to the partition.

**2318.2.5** Stud partitions subject to frequent wetting shall be of pressure treated wood or shall be protected with 15-pound asphalt-saturated felt, or by other approved design methods.

**2318.2.6** Wardrobe units serving as nonbearing partitions, prefabricated or partially prefabricated may be of 2-inch by 2-inch (51 mm by 51 mm) studs spaced not farther apart than 16 inches (406 mm) provided there is a wood-based structural panel skin-glued or nailed to the studs.

#### **2318.3 Columns and posts.**

**2318.3.1** Columns and posts shall be framed to true end bearing, shall be securely anchored against lateral and vertical forces, and shall be designed by a registered professional engineer or registered architect proficient in structural design.

**2318.3.2** The bottom of columns and posts shall be protected against deterioration by an approved product or method.

**2318.3.3** Columns and posts shall be spliced only in regions where lateral support is adequately provided about both axes and is designed by rational analysis. Such design shall be prepared, signed and sealed by a registered professional engineer or registered architect proficient in structural design.

**2318.3.4** Design dimensions of columns and posts shall not be reduced by notching, cutting or boring.

### **SECTION 2319 HIGH-VELOCITY HURRICANE ZONES – HORIZONTAL FRAMING**

#### **2319.1 Size.**

**2319.1.1** The minimum size of joists and rafters shall be as set forth in Section 2317.

**2319.1.2** The design of horizontal framing other than joists and rafters shall be as set forth in Section 2317.1.1.

**2319.1.3** Horizontal wood members independently supporting a suspended ceiling shall be not less than 2 inch by 4 inch (51 mm by 102 mm) and hangers shall be not less than the equivalent of 1 inch by 4 inch (25 mm by 102 mm) wood members providing proper nailing.

**2319.2 Spacing.** Joists and rafters, where a plaster ceiling is directly supported, shall comply with Section 2507.2.3.

#### **2319.3 Bearing.**

**2319.3.1** Joists and rafters shall have not less than three inches of bearing on wood, metal, grout filled masonry or concrete, except as provided in Sections 2319.3.2, 2319.3.3 and 2319.3.4.

#### **2319.3.2 Masonry and concrete.**

**2319.3.2.1** Joists and rafters may bear on and be anchored by steel strap anchor embedded into a grout

filled cell of the masonry or reinforced concrete, as described in Sections 2321.5.1, to a wood plate provided such wood plate is of an approved durable species or pressure treated with an approved preservative. Such plate shall be not less than 2 inch by 4 inch (51 mm by 102 mm) and attached as per Section 2318.1.4.1. The net uplift on the plate shall be limited to 300 pounds per foot (4378 N/m).

**2319.3.2.2** Joists and rafters may bear on a Product Approved channel-shaped metal saddle and fastened to the masonry by a steel strap anchor embedded into a grout filled cell of the masonry or concrete.

**2319.3.2.3** Joists and rafters may bear on masonry, provided that each joist or rafter in contact with masonry is of an approved durable species or pressure treated with an approved preservative and anchored as in Section 2319.3.2.2 above.

**2319.3.3** Floor joists may butt into a header beam if effectively toenailed and if an approved metal hanger providing not less than 3 inches (76 mm) of bearing transmits the vertical load to the top of the header, provided, however, that approved devices or other approved means of support may be used in lieu of such bearing. All hangers and devices shall have Product Approval.

**2319.3.4** Ceiling joists may butt into a header beam, as set forth for floor joists, or approved devices or other approved means of support may be used in lieu of such bearing. All devices shall have Product Approval.

**2319.3.5** In lieu of the above, bearing and anchorage may be designed by rational analysis by a registered professional engineer or registered architect proficient in structural design.

**2319.4 Splicing.** Horizontal members shall not be spliced between supports except that properly designed splices or approved end-jointed lumber may be used.

**2319.5 Notching and boring.**

**2319.5.1** Unless local unit stresses are calculated on the basis of reduced size, wood members in bending shall not be cut, notched or bored except as provided in Sections 2319.5.1.1 and 2319.5.1.2.

**2319.5.1.1** Notches may be cut in the top or bottom not deeper than one-sixth of the depth not longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Where members are notched at the ends, over bearing points, the notch depth shall not exceed one-fourth the member depth.

**2319.5.1.2** Holes may be bored in the middle one-third of the depth and length and not larger than one-sixth of the depth. Space between any two holes in the same joist shall be not less than the depth of the joist.

**2319.5.2** Where necessary to run service pipes in the space between the ceiling and floor larger than can be accommodated by the above provision, such ceilings shall be furred or provision made for headers or beams and/or for changing direction of the joists where the design permits.

**2319.6 Openings.**

**2319.6.1** Joists shall be doubled adjacent to openings where more than one joist is cut out or shall be so increased in size or number as may be needed to meet the stress requirements.

**2319.6.2** Headers shall be of the same size as the joists and where supporting more than one joist shall be double members.

**2319.6.3** Headers shall be supported by approved metal hangers or ledgers or other approved members.

**2319.7 Wood entering masonry or reinforced concrete.**

**2319.7.1** Wood joists, beams or girders which frame into masonry or reinforced concrete shall have a minimum of 1/2-inch (12.7 mm) air space at the top, end and sides or shall be preservative pressure treated or of an approved durable species.

**2319.7.2** Where masonry extends above such wood members, joists shall be fire-cut so the top edge does not enter the masonry more than 1 inch (25 mm) or shall be provided with wall plate boxes of self-releasing type or approved hangers.

**2319.7.3** Where joists enter a masonry wall required to be fire resistive, such joists shall be separated from the opposite side of the wall by at least 4 inches (102 mm) of solid masonry.

**2319.8 Floor joists.**

**2319.8.1** Floor joists under all walls or partitions parallel to the joists shall be doubled.

**2319.8.2** Doubled joists may be separated not more than 6 inches (152 mm).

**2319.8.3** Floor joists supporting concrete or grout for tile floors shall have a maximum spacing of 12 inches (305 mm).

**2319.9 Ceiling joists.**

**2319.9.1** In buildings with pitched roofs the ceiling joists, where practicable, shall be nailed to the rafters and shall be designed to carry all imposed loads including but not limited to lateral thrust.

**2319.9.2** Ceiling joists spanning more than 10 feet (3 m) shall be laterally supported at midspan.

**2319.9.3** Ceiling joists shall not be used to support rafter loads unless the joists and connections are properly designed for the total load being imposed.

**2319.10 Roof framing.** The permit documents shall include roof framing plans showing spacing and spans of all roof members indicating any fabricated elements to be designed and furnished by others and shall include the details for support and bearing of the roof structural system, for the permanent cross/lateral/diagonal bracing and anchorage required to resist dead, live and wind loads as set forth in Chapter 16 (High-Velocity Hurricane Zones). The framing plans shall also indicate the uplift forces applied on the roof, sheathing type, thickness and nailing requirements for the sheathing. The roof framing plans shall be prepared by and bear the sign and seal of, a registered professional engineer or registered architect of record proficient in structural design.

**2319.11 Roof joists.** Roof joists may cantilever over exterior walls as limited by the allowable stress, but the length of such cantilever shall not exceed one-half the length of the portion of the joist inside the building; and where the cantilever of tail joists exceeds 3 feet (914 mm), the roof joist acting as a header shall be doubled.

**2319.12 Roof rafters.**

**2319.12.1** Hip rafters, valley rafters and ridge boards shall be provided and shall be not less in size than the largest rafter framing thereto nor less than required to support the loads.

**2319.12.2 Collar ties.**

**2319.12.2.1** Collar ties and their connections shall be provided to resist the thrust of rafters and shall be designed by a registered engineer or registered architect proficient in structural design.

**2319.12.2.2** Collar ties shall not be required if the ridge is designed as a supporting beam. Such design shall be done by a registered professional engineer or registered architect proficient in structural design.

**2319.12.2.3** Ceiling joists may serve as collar ties when properly designed by a registered professional engineer or registered architect proficient in structural design.

**2319.12.3** The actual roof and ceiling dead loads may be used to resist uplift loads, but the maximum combined dead load used to resist uplift loads shall not exceed 10 pounds per square foot (479 Pa).

**2319.13 Heavy timber construction.** Heavy timber construction of floors or roofs shall comply with the standards in Section 2314.4. All heavy timber construction shall be designed by a registered professional engineer or registered architect proficient in structural design to withstand the loads required in Chapter 16 (High-Velocity Hurricane Zones).

**2319.14 Vertically laminated beams.** Vertically laminated built-up beams shall be designed and made up of members continuous from bearing to bearing.

**2319.15 Glued-laminated members.** Glued-laminated members shall be designed to comply with applicable AITC standards adopted by this code.

**2319.16 Stair stringers.**

**2319.16.1** Stair stringers shall, where practicable, be framed to provide 4 inches (102 mm) of bearing at the ends.

**2319.16.2** Where it is not practicable to provide such bearing, the stringers shall be hung in steel hangers of approved type.

**2319.16.3** Stair stringers shall not be notched or cut in the effective area.

**2319.16.4** Two stringers shall be provided for each flight of stairs no more than 36 inches (914 mm) in width, and an additional stringer shall be provided for each 18 inches (457 mm) of additional stair width, except for public stairs where the number of stringers shall be determined by rational analysis by a registered professional engineer or registered architect proficient in structural design.

**2319.17 Wood trusses.**

**2319.17.1 Trussed rafters.** Trussed rafters shall be designed by methods admitting of rational analysis by a registered professional engineer or registered architect proficient in structural design based on the standards set forth in Section 2314.4.

**2319.17.1.1** Where steel is used for connecting wood members, such connectors shall be not less than 20 U.S. gage and shall be protected with a zinc coating conforming to ASTM A 361 set forth in Chapter 35 of this code. Connectors shall have Product Approval or shall be designed by methods admitting of rational analysis by a registered professional engineer or registered architect proficient in structural design.

**2319.17.1.2** Where a ceiling is to be attached directly to the underside of trusses, the trusses shall be laterally braced with continuous 1-inch by 4-inch (25 mm by 102 mm) members nailed with 8d common nails to the upper side of the bottom chord at panel points but not to exceed 10 feet (3 m) apart. This lateral bracing shall be restrained at each end and at 20-foot (6 m) intervals. Dry-wall may be considered a rigid ceiling in enclosed areas where it is protected from the elements. The drywall ceiling is not to be considered a ceiling diaphragm.

**2319.17.1.3** Where a ceiling is to be attached to wood stripping which is nailed to the underside of the bottom chord of trusses with two-8d common nails at each intersection, stripping shall be not less than 1 inch by 3 inches (25 mm by 76 mm) spaced not more than 24 inches (610 mm) apart. Wood stripping may be replaced by furring channels. Furring channels shall be a minimum of  $\frac{7}{8}$  inch (22 mm) hat-shaped channels weighing 287 pounds per 1000 lineal feet (41.4 kg per 100 m) with minimum based steel of 0.0179 inch (0.445 mm) and complying with ASTM C 645 attached to trusses with minimum two #6  $1\frac{1}{4}$  inch (32 mm) screws per intersection. Said stripping or metal furring channels may serve also as the lateral bracing of the truss bottom chord so as to minimize the effects of buckling of the bottom chord when subjected to compressive stresses under reverse load conditions. In addition, the rigid ceiling that is created by this 1-inch by 3-inch (25 mm by 76 mm) stripping or metal furring channels must also be restrained from lateral movements, in accordance with the details provided by the architect or professional engineer of record.

**Exception:** Where fire-rated design assembly does not allow for this specific installation, see Section 2319.17.1.2

**2319.17.1.4** Where a ceiling is attached to wood members suspended beneath trusses, the provisions of Section 2319.1 shall apply.

**2319.17.2 Prefabricated wood trusses.** Prefabricated wood trusses shall comply with this section.

**2319.17.2.1 Design.**

**2319.17.2.1.1** Prefabricated wood trusses shall be designed by a registered professional engineer (delegated engineer) and fabricated in accordance with the *National Design Standard for Metal Plate Connected*

*Wood Truss Construction of the Truss Plate Institute (TPI).* The truss system designer (delegated engineer) shall prepare the truss system shop drawings. Such shop drawings shall be submitted to the building official for review and approval. The shop drawings shall meet the following requirements:

1. All shop drawings shall be in conformity with the architect or engineer of record framing plans unless prior written approval is obtained from the architect or engineer of record. If reframing is approved, the architect or engineer of record shall resubmit revised framing plans to the building official after receiving updated plans from the delegated engineer showing all adjustments necessary to safely transmit all applied loads to the foundation.
2. Permanent bracing of individual truss members may be required on certain members of the trusses to prevent the members from buckling in the plane normal to the trusses (buckling in the narrow direction). This bracing shall be designed for both upward and downward loads and shall be shown on the individual truss drawings (truss engineering usually shown on 8½-inch by 11-inch (216 mm by 279 mm) sheets (“A” size drawings). The design of this bracing shall be the responsibility of the delegated engineer. The contractor shall be responsible for seeing that this bracing is properly installed. This bracing may be in the form of (but not limited to) “T” bracing of an individual member, or lateral bracing of a series of members common to a number of trusses. Where lateral bracing is used, this bracing shall be restrained against lateral movement, in accordance with details provided by the delegated engineer or by the architect or professional engineer of record. All details and sections required to show the size and connections of all secondary members will be supplied on the delegated engineering plans and shall show all framing, connections and bracing on one or more primary plans of minimum size 24 inches by 36 inches (610 mm by 914 mm).
3. A size 8½-inches by 11-inches (216 mm by 279 mm) cut sheets showing individual member design shall also be furnished to the architect or engineer of record so that all gravity and uplift loads shown on these cut sheets can be transferred to the primary plans.
4. The size and location of all plates at each joint shall be shown on the truss design drawings.
5. The connection between trusses shall be detailed in the shop drawings. Hip sets shall be detailed in a manner to indicate all connections according to engineering drawings for the attachment of skewed members.

6. Truss design drawings shall indicate the support and minimum bearing of the roof structural system, the permanent cross/lateral bracing, bracing to transfer member buckling forces to the structure and all bracing and anchorage required to resist uplift and lateral forces.
7. Flat and floor trusses must be clearly marked so that they will be installed right side up. These marks must remain after the flooring, sheathing and insulation have been installed.

The intent of the above requirements is to provide all information on framing, connections and bracing on one composite set of plans approved by the architect or engineer of record to aid in the review, approval and field inspections for the portion of the property.

**2319.17.2.1.2** Trusses shall be designed for wind loads per Chapter 16 (High-Velocity Hurricane Zones), uniformly distributed live, dead and concentrated loads, and such loads shall be indicated on the roof framing plans and the truss design drawings. Where a girder or truss is subjected to concentrated loads or any unusual loading condition, such conditions must be clearly indicated on the roof framing plans and on the truss design drawings. Where truss members have been cut, shifted or altered in any manner to meet construction needs or for any other reason, additional drawings and additional calculations must be prepared, signed and sealed by the truss designer (a Florida-delegated engineer). Such additional drawings and calculations must be approved by the engineer or architect of record and must be submitted to the building official for review and approval.

**2319.17.2.1.3** Roof trusses shall be designed for a minimum live load of 30 psf (1436 Pa), a minimum dead load of 15 psf (718 Pa) on the top chord, and a minimum dead load of 10 psf (479 Pa) on the bottom chord; and wind loads per Chapter 16 of this code. Where the roof design is such that water is not directed to the interior of the roof and there are no parapets or other roof edge drainage obstructions, roof trusses with slopes of 1½:12 or greater may be designed for a live load of 20 psf (958 Pa) and a minimum total load of 45 psf (2155 Pa). Adjustment of the allowable design stress for load duration shall be in accordance with *National Design Specification for Wood Construction*.

**2319.17.2.1.4** The allowable deflection under live load for trusses shall not exceed span/360 for plastered ceilings, span/240 for unplastered finished ceilings, or span/180 for trusses without a ceiling.

**2319.17.2.1.5** Flat roof trusses shall be designed for not less than the loads set forth in Section 2319.17.2.1.3 above, except that the dead load on the top chord may be taken as 10 psf (479 Pa) in lieu of 15 psf (718 Pa), and the total load reduced to 50 psf (2394 Pa). Adjustment of the allowable design stress for load

duration shall be in accordance with *National Design Specification for Wood Construction*.

**2319.17.2.1.6** Where gable end trusses are permitted in this code, they shall be designed for a minimum live load of 30 psf (1436 Pa) and a minimum dead load of 15 psf (718 Pa) on the top chord. The minimum load of 10 psf (479 Pa) on the bottom chord may be omitted where continuous support is provided. In addition, the gable end trusses shall be designed to sustain wind load as specified in Chapter 16 (High-Velocity Hurricane Zones) but not less than 30 psf (1436 Pa) perpendicular to the plane of the truss. Such trusses shall use a rationally designed system to resist lateral wind loads and be anchored to the substructure at intervals no greater than 4 feet (1219 mm) on center to resist the uplift forces and shall be designed to transfer the loads to the substructure. The design of the system used to resist the lateral loads imposed on the truss shall be prepared by the engineer or architect of record.

**2319.17.2.1.7** When girders exceed two members and when girder reactions exceed the capacity of standard connectors or hangers, these reactions shall be shown on the drawings and the connection must be designed, signed and sealed by a registered professional engineer or registered architect proficient in structural design and such design shall be included as part of the shop drawings.

**2319.17.2.1.8** All trusses shall be properly braced to act as a system. Such bracing shall be included as part of the design document.

#### **2319.17.2.2 Materials and specifications.**

**2319.17.2.2.1** Trusses shall be fabricated applying the design values listed in the standard *Design Values for Wood Construction of the American Forest and Paper Association*.

**2319.17.2.2.2** Top and bottom chords shall be of No. 2 Grade or better. Web members shall be of No. 3 Grade or better. A chord member is defined as the entire top or bottom truss member which may consist of shorter spliced pieces.

**2319.17.2.2.3** For trusses spanning 20 feet (6 m) or less, the minimum percentage of grade-marked members among top and bottom chords shall be 50 percent.

**2319.17.2.2.4** For trusses spanning more than 20 feet (6 m) the minimum percentage of grade-marked members among top and bottom chords shall be 75 percent, and there shall be a minimum of one marked web on each truss.

**2319.17.2.2.5** All lumber shall be 2 inches by 4 inches (51 mm by 102 mm) nominal or larger, and no 2 inch (51 mm) nominal member shall be less in size than 1½ inches (38 mm).

**2319.17.2.2.6** The moisture content of all lumber used in wood truss fabrication shall not exceed 19 percent.

**2319.17.2.2.7** Connector plates shall be not less than 20 gauge galvanized steel meeting ASTM A 653/A 653M or A 924/A 924M, and shall be identified by the manufacturer's stamp. The size and location of all plates shall be shown on the truss design drawings. Connectors shall have Product Approval.

**2319.17.2.2.8** All connector plates over 3 inches (76 mm) and 25 percent of 3 inches (76 mm) or less, as per TPI standards, shall bear the name, logo or other markings, which clearly identify the manufacturer. Semiannually, plate manufacturers shall certify compliance with the provisions of Section 6 of the Truss Plate Institute, TPI, *National Design Standard for Metal Plate Connected Wood Truss Construction*, with respect to the grade of steel, thickness or gauge of material, and galvanizing to ASTM G 60 as a minimum. This certification requirement shall be satisfied by submitting by an approved independent laboratory to the certification agency.

#### **2319.17.2.3 Fabrication.**

**2319.17.2.3.1** Manufacturers of prefabricated wood truss assemblies shall obtain a valid certificate of competency from the authority having jurisdiction.

**2319.17.2.3.2** Each truss shall bear the fabricators stamp on a web member and 75 percent shall be placed so as to be clearly visible after erection and before placement of ceiling.

**2319.17.2.3.3** Multiple member girder trusses shall be predrilled at the truss plant for connection bolts only. Hanger bolt holes shall be drilled on-site on location indicated on approved drawings.

**2319.17.2.3.4** Each manufacturer or fabricator shall retain the services of applicable organizations among those listed below for monthly inspections of the lumber grade used in fabrication. Following each inspection, a report shall be submitted by the inspection agency to the authority having jurisdiction. All inspection agencies providing any type of inspection services shall be approved by the authority having jurisdiction.

For Pine: Southern Pine Inspection Bureau or Timber Products grading agencies with appropriate jurisdiction.

For Douglas Fir,  
Hem-Fir or  
Fir-Larch:

Western Wood Products Association or West Coast Lumber Inspection Bureau. Timber Products Inspection Inc. or other grading agencies with appropriate jurisdiction.

**2319.17.2.3.5** In addition, the fabricator shall employ an approved testing laboratory to conduct inspections of fabrication compliance. Such inspections shall be made unannounced and at random at least once a month. Following each inspection, a report on



approved forms shall be submitted by the laboratory to the authority having jurisdiction and such reports shall bear the date, signature and seal of the supervising Florida-registered architect or professional engineer.

**2319.17.2.3.6** When there is evidence of noncompliance with the provisions for fabrication set forth in this paragraph or with the approved plans, the authority having jurisdiction may require the inspection laboratory to make additional job-site or plant inspections.

**2319.17.2.3.7** The authority having jurisdiction may require load testing on noncomplying wood trusses. The test results shall be reported to the authority having jurisdiction.

**2319.17.2.3.8** Failure of units tested or receipt of inspection reports indicating fabrication not in accordance with approved truss design drawings, or failure to submit required inspection and/or test reports, shall be cause for suspension or revocation of the certificate of competency of the manufacturer or fabricator.

#### **2319.17.2.4 Truss erection.**

**2319.17.2.4.1** All trusses shall be erected in accordance with TPI/WTCA BCSI 1 in addition to any requirements indicated on the approved permit document.

**2319.17.2.4.2** For trusses having an overall length of the bottom chord in excess of 35 feet (10.7 m) or 6 feet (1829 mm) overall height erection shall be supervised by either a registered professional engineer or registered architect retained by the contractor. A retainer letter from the registered professional engineer or registered architect shall be submitted along with the shop drawings as part of the permit document.

**2319.17.2.4.3** Temporary bracing shall be required during the erection of roof trusses to keep the trusses in a true plumb position and to prevent toppling of the trusses during erection, until the roof sheathing is applied. The provisions for temporary bracing shown in TPI/WTCA BCSI 1 shall be used for this bracing or a professional engineer or architect shall design the temporary bracing system. The ultimate responsibility to see this bracing is installed properly during the erection process lies with the permit holder. This bracing is extremely important for the protection of life and property during the erection process. Temporary truss bracing shall always be required.

**2319.17.2.4.4** At gable ends, this diaphragm shall be designed to transmit lateral loads imposed on the gable to roof diaphragms and/or ceiling diaphragms where available. Where the wall supporting the gable is not designed to withstand lateral loads independent of the gable (by using shear walls or other methods), anchorage of the gable to the wall shall be designed to transmit the loads from the wall to the bracing and the

bracing designed to transmit the lateral loads from the gable and wall to the roof diaphragms and/or ceiling diaphragms where available. Ceiling diaphragms that provide lateral support at gable walls shall be designed by the architect or professional engineer of record, and shall have continuous bottom chord bracing, end restraints, intermediate restraints and conditions so as to sufficiently transfer the lateral loads at the top of the gable end walls to the intersecting shear walls. In no case shall the rigid ceiling as, defined in Section 2319.17.1.2, be used as an integral part of the system needed for lateral bracing of the gable end walls.

**2319.17.2.4.5** Where masonry or reinforced concrete extends above wood trusses; trusses shall be designed so as not to compromise the structural integrity of the masonry or concrete wall it abuts in the event of collapse caused by fire.

### **SECTION 2320 HIGH-VELOCITY HURRICANE ZONES — FIRESTOPS**

**2320.1** Firestopping shall be provided to cut off all concealed draft spaces, both vertical and horizontal.

**2320.1.1** Firestops shall form effective fire barriers between stories and between a story and roof space.

**2320.1.2** Firestopping shall be tightly and securely fitted into place and where of wood, shall be not less than a nominal 2 inches (51 mm) in thickness.

**2320.1.3** Spaces between chimneys and wood framing shall be solidly filled with mortar or loose incombustible materials supported on incombustible supports.

**2320.1.4** Firestopping shall consist of 2 inch (51 mm) nominal lumber, or two thicknesses of 1 inch (25 mm) nominal lumber with broken lap joints, or 1 thickness of  $2\frac{3}{32}$ -inch (18 mm) plywood, with joints backed by  $2\frac{3}{32}$ -inch (18 mm) plywood, or other approved materials.

**2320.1.5** Draftstopping materials shall be not less than  $\frac{3}{8}$ -inch (9.5 mm) plywood or other approved materials adequately supported.

**2320.1.6** Required firestops and draftstops shall be continuous, and such continuity shall be maintained throughout. Penetrations of firestops or draft stops shall be sealed or protected in an approved manner.

**2320.1.7** Ventilation of concealed roof spaces shall be maintained in accordance with Section 2326.3.2.

**2320.2** Firestopping shall be installed in wood frame construction in the locations specified in Sections 2320.2.1 through 2320.2.6.

**2320.2.1** In concealed spaces of stud walls and partitions including furred spaces at ceiling and floor levels to limit the maximum dimension of any concealed space to 8 feet (2438 mm).

**2320.2.2** At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings and similar features.

**2320.2.3** In concealed spaces between stair stringers at least once in the middle of each run, at the top and bottom, and between studs along and in line with adjacent run of stairs of the run.

**2320.2.4** At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels with approved noncombustible materials, except in the case of approved metal chimney installation.

**2320.2.5** In concealed spaces created by an assembly of floor joists, firestopping shall be provided for the full depth of the joists at the ends and over the support.

**2320.2.6** Around the top, bottom and sides of door pockets.

**2320.3 Draftstopping.** Draftstopping shall be provided in wood frame construction in the locations specified in Sections 2320.3.1 and 2320.3.2.

**2320.3.1 Floor-ceiling assemblies.**

**2320.3.1.1 Group B and M occupancies.** In the floor-ceiling assemblies above and in line with the tenant separation, when tenant separation walls do not extend to the floor sheathing above.

**2320.3.1.2 Groups R1, R2 and R4 occupancies.** In floor-ceiling assemblies separating usable spaces into two or more approximate areas with no area greater than 500 square feet (46.5 m<sup>2</sup>). Draftstopping shall be provided parallel to the main framing members in the floor-ceiling assemblies of multiple-family dwellings, motels and hotels above and in line with the tenant separation, when tenant separation walls do not extend to the floor sheathing above.

**2320.3.1.3 Other occupancies.** All other buildings, in floor-ceiling assemblies so that horizontal areas do not exceed 1,000 square feet (93 m<sup>2</sup>).

**2320.3.2 Attics.**

**2320.3.2.1 Group R1.** In the floor-ceiling assemblies above and in line with the tenant separation, when tenant separation walls do not extend to the floor sheathing above.

**2320.3.2.2 Group R3.** None required.

**Exceptions:**

1. Where corridor walls provide a tenant separation, draftstopping shall be required above only one of the corridor walls.
2. Where flat roofs with solid joist construction are used, draftstopping over tenant separation walls is not required.
3. Where approved sprinklers are provided, draftstopping shall be required for attic spaces over 9000 square feet (836 m<sup>2</sup>) in area.

**2320.3.2.3 Other buildings.** In attic spaces so that horizontal areas do not exceed 3,000 square feet (279 m<sup>2</sup>).

**Exceptions:**

1. Where flat roofs with solid joist construction are used, draftstopping over tenant separation walls is not required.
2. Where approved sprinklers are provided, the area may be tripled.

**SECTION 2321  
HIGH-VELOCITY HURRICANE ZONES —  
ANCHORAGE**

**2321.1** Anchorage shall be continuous from the foundation to the roof and shall satisfy the uplift requirements of Section 1620.

**2321.2 Joists.**

**2321.2.1** Fire-cuts into a masonry wall shall be anchored to the concrete beam on which they bear.

**2321.2.2** Such anchors shall be spaced not more than 4 feet (1219 mm) apart and shall be placed at opposite ends across the building on the same run of joists.

**2321.3** Joists shall be nailed to bearing plates, where such plates occur, to each other where continuous at a lap and to the studs where such studs are contiguous; and ceiling joists shall be nailed to roof rafters where contiguous.

**2321.4** Every roof rafter and/or roof joist shall be anchored to the beam or studs on which they bear, and roof rafters opposing at a ridge shall be anchored across the ridge as set forth in Section 2321.6.

**2321.5 Anchorage to concrete.**

**2321.5.1** Anchorage designed to resist uplift forces, securing wood to concrete shall be steel straps embedded in the concrete minimum of 4 inches (102 mm) with hooking devices to top steel of tie beam designed to withstand the uplift forces set forth by the design professional. Straps shall be approved under the criteria set by the certification agency. All anchors and related fasteners shall be galvanized.

**2321.5.2** As an alternate to using the straps described in this section, the building official may approve other anchorage submitted by a Florida-registered professional engineer or a Florida-registered architect, proficient in structural design, provided that the information set forth in Section 2321.7(1), (2) and (3) submitted in connection with such anchors and such anchors and the proposed assembly otherwise comply with the requirements of this code.

**2321.6 Anchorage to wood.**

**2321.6.1** Anchorage designed to resist uplift forces, securing wood to wood shall be steel straps nailed to each member and shall be designed to resist uplift forces set forth by the design professional. Straps shall be approved under the criteria set by the certification agency. All anchors and relative nails shall be galvanized.

**2321.6.2** As an alternate to using straps described in this section, the building official may approve other anchorage submitted by a Florida-registered architect or a Florida registered professional engineer, proficient in structural design, provided that the information set forth in Section 2321.7(1), (2) and (3) submitted in connection with such anchors and such anchors and the proposed assembly otherwise comply with the requirements of this code.

**2321.7 Testing of anchoring.** Anchoring required by Sections 2321.5 and 2321.6 shall be tested under the following criteria:

1. Concrete to wood straps: Minimum design uplift load 700 pounds (3114 N), with four 16d nails with upper end bent over truss chord and nailed. Nails shall be clinched. Anchors shall have devices to hook into upper tie beam steel and embedded a minimum of 4 inches (102 mm) in concrete.
2. Wood to wood straps: Minimum design uplift 700 pounds (3114 N) with 4 16d nails in each member.
3. Other anchors: Minimum design uplift 700 pounds (3114 N).
4. The criteria stated in Section 2321.7(1), (2) and (3) above are minimum requirements for product approval for the certification agency. Anchor design and uplift forces shall be submitted to the certification agency for approval together with sufficient documentation and test data to verify performance. A product approval shall be maintained at the job site for the inspector to compare with the uplift force requirements of the design professional as shown on approved plans.

## SECTION 2322 HIGH-VELOCITY HURRICANE ZONES — SHEATHING

### 2322.1 Floor sheathing.

**2322.1.1** Floor sheathing, where a part of a required fire-resistive assembly, shall comply with a nationally recognized testing agency (Underwriter's Laboratory, Factory Mutual, etc.).

**2322.1.2** The finish floor shall be tongue-and-grooved not less than nominal 1 inch (25 mm) lumber laid perpendicular to the joists with end joints on the joists, or a subfloor shall be provided as set forth in Sections 2322.1.3, 2322.1.4, 2322.1.5, and 2322.1.6.

**2322.1.3** Square-edged or spaced subflooring may be used only under a finish floor having a strength equal to or greater than  $\frac{1}{2}$ -inch (12.7 mm) tongue-and-groove wood strip flooring; and under finish floors of less strength, a tongue-and-groove or plywood subfloor shall be required.

**2322.1.4** Lumber subflooring shall be not less than  $\frac{5}{8}$ -inch (17 mm) thick when joists are spaced no more than 16 inches (406 mm) on center nor less than  $\frac{3}{4}$ -inch (19 mm) thick when joists are spaced no more than 24 inches (610 mm) on center. End joints shall be on joists, joints shall be staggered and parallel to the joists, and ends at walls and similar places shall be supported by a ribbon or by blocking.

**2322.1.5** Plywood subfloors of C-D grade or underlayment grade bonded to wood joist using adhesives meeting the requirements of ASTM D 3498 shall be applied as indicated in Section 2322.1.6.

**2322.1.6** Plywood subflooring shall be continuous over two or more spans with face grain perpendicular to the supports. The allowable spans shall not exceed those set forth in Table 2322.1.6.

**TABLE 2322.1.6  
PLYWOOD SUBFLOOR<sup>1</sup>**

PANEL SPAN RATING <sup>2</sup>	MAXIMUM PLYWOOD SPAN (in.) <sup>3</sup>
32/16	16 <sup>4</sup>
40/20	20 <sup>4</sup>
48/24	24

For SI: 1 inch = 25.4 mm.

NOTES:

1. These values apply for Sheathing C-D and C-C grades only. Spans shall be limited to values shown, and reduced for the possible effects of concentrated loads.
2. Span Ratings shall appear on all panels.
3. Plywood edges shall have approved tongue-and-groove joints or shall be supported with blocking unless  $\frac{1}{4}$  inch minimum thickness underlay is installed or  $\frac{1}{2}$  inch of approved cellular or lightweight concrete is installed or unless finish floor is 1 inch nominal wood strip. Allowable uniform load based on deflection of 1/360 of span is 100 pounds per square foot.
4. May be 24 inches if nominal 1 inch wood strip finish floor is laid at right angles to joists.

**2322.1.6.1** Plywood panels shall be nailed to supports with 6d common nails when up to  $\frac{1}{2}$ -inch thick (13 mm), 8d common nails when  $\frac{19}{32}$ - to  $\frac{3}{4}$ -inch (15 to 19 mm) thick and 10d common nails or 8d ring shank when  $1\frac{1}{8}$ -inches (29 mm) thick.

**2322.1.6.2** Nail spacing shall be 6 inches (152 mm) o.c. at panel edges and 10 inches (254 mm) o.c. at intermediate supports.

**2322.1.7** Any other subfloor panel shall have certification agency approval and shall be installed in accordance with the procedures set forth in the approval.

**2322.1.8** Flooring shall be nailed with 8d common nails up to  $\frac{3}{4}$ -inch (19 mm) thick, and 10d common nails or 8d ring shank nails when greater than  $\frac{3}{4}$ -inch (19 mm) thick up to  $1\frac{1}{8}$ -inches (29 mm) thick.

**2322.1.8.1** Nails shall be hand driven 8d common nails [0.131 inch (3.3 mm) diameter by  $2\frac{1}{2}$  inches (63.5 mm) long with 0.281 inch (7.1 mm) diameter full round head] or power driven 8d nails of the same dimensions (0.131 inch diameter by  $2\frac{1}{2}$ -inches long with 0.281 inch diameter full round head). Nails of a smaller diameter or length may be used only when approved by an architect or professional engineer and only when the spacing is reduced accordingly.

**2322.1.8.2** Nails shall be hand driven 10d common nails [0.148 inch (3.8 mm) diameter by 3 inch (76 mm) long with 0.312 inch (7.9 mm) diameter full round head] or power driven 10d nails of the same dimensions [0.148 inch (3.8 mm) diameter by 3 inch (76 mm) long with 0.312 inch (7.9 mm) diameter full round head]. Nails of a smaller diameter or length may be used only when

approved by an architect or professional engineer and only when the spacing is reduced accordingly.

**2322.1.9** Nail spacing shall be 6 inches (152 mm) on center at panel edges and 10 inches (254 mm) on center at intermediate supports.

**2322.1.10** Flooring shall be nailed with 8d common nails, not less than two, in each board at each support.

**2322.1.11** Floors for heavy timber buildings shall be sheathed as specified for mill floors, Section 2319.13.

**2322.1.12** Flooring shall not extend closer than  $\frac{1}{2}$ -inch (13 mm) from masonry walls.

**2322.1.13** If resilient flooring is to be applied directly to a plywood subfloor without separate underlayment, the plywood shall have a top ply of C-plugged grade or better, and the ply immediately under the face shall be at least C grade unless the face ply is  $\frac{1}{6}$ -inch (4.2 mm) or more in nominal thickness. Plywood shall be continuous over two or more spans with face grain perpendicular to supports. Maximum thickness and maximum joist spacing shall comply with Table 2322.1.13.

**TABLE 2322.1.13**  
**ALLOWABLE SPAN FOR PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT<sup>1</sup>**  
**(SINGLE FLOOR PANELS)**

SPECIES GROUPS	MAXIMUM PLYWOOD SPAN (in.) <sup>2,3</sup>			
	16 <sup>4</sup>	5/8 <sup>4</sup>	24	48
1	1/2"	5/8"	3/4"	
2,3	5/8"	3/4"	7/8"	
4	3/4"	7/8"	1"	
1, 2 and 3				1-1/8"

For SI: 1 inch = 25.4 mm.

**NOTES:**

- Applicable underlayment grade, C-C (plugged) and all grades of sanded Exterior type plywood.
- Spans shall be limited to values shown and reduced for the possible effects of concentrated loads.
- Allowable uniform load based on deflection of  $\frac{1}{360}$  of span is 100 pounds per square foot except that total load for 48" on center is 65 pounds per square foot. Plywood edges shall have approved tongue-and-groove joints or shall be supported with blocking unless  $\frac{1}{4}$  inch minimum thickness underlay is installed or  $\frac{1}{2}$  inch of approved cellular or lightweight concrete is placed over the subfloor and the sheathing is rated for Exposure 1.
- If a wood finish floor is laid perpendicular to the joists or supports, thickness shown for 16 inch and 20 inch spans may be used for 24 inch spans.

**2322.1.14** Underlayment hardboard shall meet the property requirements for  $\frac{7}{32}$ -inch (5.6 mm) and  $\frac{1}{4}$ -inch (6.4 mm) service hardboard and shall be 0.215 +/-0.005 inch (5.5 +/-0.13 mm) thickness; when supported in subflooring such subflooring shall comply with the requirements of Sections 2322.1.3, 2322.1.4, 2322.1.5, and 2322.1.6.

**2322.1.15** Particleboard floor underlayment shall conform to Type 1-B-1 of the standard listed in Section 2314.4. Underlayment shall be not less than  $\frac{1}{4}$ -inch (6.4 mm) in thickness and shall be installed in accordance with the installation instructions of the National Particleboard Association.

**2322.1.16 Diaphragm boundaries.** All floor sheathing acting as a diaphragm shall be attached to a minimum 2-inch-thick (51 mm) nominal nailer with its depth equal to or one size greater than the intersecting top chord. The nailer shall be connected to the wall to resist the gravity loads from the floor, wind pressure/suction from the exterior wall and the diaphragm forces. The floor sheathing shall be attached to the nailer to resist the wind pressure/suction from the exterior wall and the diaphragm forces.

**2322.2 Roof sheathing.**

**2322.2.1** Wood roof sheathing shall be boards or shall be plywood.

**2322.2.2** Board roof sheathing shall have a net thickness of not less than  $\frac{3}{4}$ -inch (19 mm) when the span is not more than 28 inches (711 mm) or  $\frac{5}{8}$ -inch (17 mm) when the span is not more than 24 inches (610 mm), shall have staggered joints and shall be nailed with 8d common nails not less than two in each 6 inch board nor three in each 8-inch (203 mm) board at each support.

**2322.2.3** Plywood roof sheathing shall be rated for Exposure 1, have a minimum nominal thickness of  $\frac{19}{32}$ -inch (15 mm) and shall be continuous over two or more spans with face grain perpendicular to supports. Roof sheathing panels shall be provided with a minimum of 2 inch by 4 inch (51 mm by 102 mm) edgewise blocking at all horizontal panel joints with edge spacing in accordance with manufacturer's specifications, for a distance at least 4 feet (1219 mm) from each gable end. The allowable spans shall not exceed those set forth in Table 2322.2.3.

**2322.2.4** Plywood panels shall be nailed to supports with 8d ring shank nails.

**2322.2.5** Nail spacing shall be 6 inches (152 mm) on center at panel edges and at intermediate supports. Nail spacing shall be 4 inches (102 mm) on center at gable ends with either 8d ring shank nails or 10d common nails.

**2322.2.5.1** Nails shall be hand driven 8d ring shank or power driven 8d ring shank nails of the following minimum dimensions: (a) 0.113 inch (2.9 mm) nominal shank diameter, (b) ring diameter of 0.012 inch (0.3 mm) over shank diameter, (c) 16 to 20 rings per inch, (d) 0.280 inch (7.1 mm) full round head diameter, (e) 2 inch (60.3 mm) nail length. Nails of a smaller diameter or length may be used only when approved by an architect or professional engineer and only when the spacing is reduced accordingly.

**2322.2.5.2** Nails at gable ends shall be hand driven 8d ring shank or power driven 8d ring shank nails of the following minimum dimensions: (a) 0.113 inch (2.9 mm) nominal shank diameter, (b) ring diameter of 0.012 inch (0.3 mm) over shank diameter, (c) 16 to 20 rings per inch, (d) 0.280 inch (7.1 mm) full round head diameter, (e) 2  $\frac{3}{8}$  inch (60.3 mm) nail length or as an alternative hand driven 10d common nails [0.148 inch (4 mm) diameter by 3 inches (76 mm) long with 0.312 inch (7.9 mm) diameter full round head] or power driven 10d nails of the same dimensions [0.148 inch (4 mm) diameter by 3 inches (76 mm) long with 0.312-inch-diameter (8 mm)

full round head]. Nails of a smaller diameter or length may be used only when approved by an architect or professional engineer and only when the spacing is reduced accordingly. Other products with unique fastening methods may be substituted for these nailing requirements as approved by the building official and verified by testing.

**2322.2.5.3** Other products with unique fastening methods may be substituted for these nailing requirements as approved by the building official and verified by testing.

**TABLE 2322.2.3  
ALLOWABLE SPAN FOR PLYWOOD ROOF SHEATHING<sup>1</sup>**

PANEL SPAN RATING <sup>2</sup>	MAXIMUM SPAN IF BLOCK OR OTHER EDGE SUPPORTS (IN.)	MAXIMUM SPAN WITHOUT EDGE SUPPORT (IN.)
32/16	24	24
40/20	40	32
48/24	48	36

For SI: 1 inch = 25.4 mm.

**NOTES:**

- Values apply to sheathing grade, C-C and C-D panels.
- Span Rating appears on all C-C and C-D panels.

**2322.2.6** Roof sheathing for heavy timber construction shall comply with Section 2319.13 of this code.

**2322.2.7 Diaphragm boundaries.** All roof sheathing acting as a diaphragm shall be attached to a minimum 2 inch (51 mm) thick nominal member with its depth equal to or one size greater than the intersecting top chord. This shall be achieved with a continuous structural subfascia, fascia or blocking at 4 inches (102 mm) on center with nails as required for the appropriate thickness of sheathing.

**2322.2.8** When existing roofs are reroofed to the point that the existing roofing is removed down to the sheathing, the existing roof sheathing shall be renailed with 8d common nails [0.131 inch (3.3 mm) diameter by 2-1/2 inches (63.5 mm) long with 0.281 inch (7.9 mm) diameter full round head]. Nail spacing shall be 6 inches (152 mm) on center at panel edges, 6 inches (152 mm) on center at intermediate supports and where applicable 4 inches (102 mm) on center over gable ends and subfascia. Existing fasteners may be used to achieve such minimum spacing.

**2322.3 Storm sheathing.** Exterior stud walls shall be sheathed to resist the racking load of wind as set forth in Section 1620 and the concentrated loads that result from hurricane-generated wind-borne debris as set forth in Section 1626 of this code and shall be at a minimum any of the following types:

- Tightly fitted, diagonally placed boards not less than 5/8-inch (17 mm) thickness, nailed with three 8d common nails to each support for 1 inch by 6 inch (25 mm by 152 mm) boards and four 8d common nails for 1 inch by 8 inches (25 mm by 203 mm) boards.
- Wall sheathing shall be plywood, or Product Approved structural panel, rated Exposure 1 with a minimum thickness of 19/32-inch (15 mm) and shall be applied to studs spaced not more than 16 inches (406 mm) on center. Wall sheathing shall be continuous over three or more supports and shall be nailed to such supports with 8d

common nails. Nail spacing shall not exceed 6 inches (152 mm) on center at panel edges and all intermediate supports. Nail spacing shall be 4 inches (102 mm) on center at corner studs, in all cases.

- When plywood panel, or Product Approved structural panel, sheathing is used, building paper and diagonal wall bracing can be omitted.
- When siding such as shingles nailed only to plywood or Product Approved structural panel sheathing, the panel shall be applied with face grain across studs.

**2322.4 Exterior wall cladding.**

**2322.4.1** Plywood, if protected with stucco, may serve for both sheathing and exterior cladding provided:

- The panel thickness shall be not less than 19/32-inch (15 mm) and Texture 1-11 panels, and the supporting studs shall be spaced not more than 16 inches (406 mm) o.c.
- All joints shall be backed solidly with 2 inch (51 mm) nominal blocking or studs or the joints shall be lapped horizontally or otherwise watertight.
- Nailing shall be as set forth in Section 2322.3(2).

**2322.4.2** Where storm sheathing is provided in accordance with Section 2322.3, exterior cladding may be one of the following:

- Wood siding shall be installed according to its Product Approval.
- Wood shingles or shakes attached to the storm sheathing, and/or to nailing boards or shingle backer securely attached to the storm sheathing. The minimum thickness of wood shingles or shakes between nailing boards shall be 3/8-inch (9.5 mm).
- Hardboard of siding quality for exterior use shall be applied in accordance with the Product Approval.

**SECTION 2323**

**HIGH-VELOCITY HURRICANE ZONES—FURRING**

**2323.1** Where the interior of masonry walls is furred, such furring shall be treated and firestopped as herein required and shall be securely fastened to the masonry with not less than one cut nail in alternate course of block.

**SECTION 2324**

**HIGH-VELOCITY HURRICANE ZONES—CONNECTORS**

**2324.1** The allowable loads on all types of connectors shall be as set forth in the standards listed in Section 2314.4 and Table 2324.1.

**2324.2** Nails, bolts and other metal connectors that are used in locations exposed to the weather shall be galvanized or otherwise corrosion resistant.

**2324.3** In general, nails shall penetrate the second member a distance equal to the thickness of the member being nailed thereto. There shall be not less than two nails in any connection.

TABLE 2324.1  
NAIL CONNECTION FOR WOOD MEMBERS

CONNECTION	COMMON NAILS	NUMBER OR SPACING
Joists to sill or girder, toe nail	16d	2
Bridging to joist, toe nail	8d	2 each end
1 inch × 6 inch subfloor or less to each joist, face nail	8d	2
Over 1 inch × 6 inch subfloor to each joist, face nail	8d	3 + 1 for each size increase
2 inches subfloor to joist or girder, blind and face nail	16d	2
Sole plate to joist or blocking, face nail	16d	16 inches o.c.
Top or sole plate to stud, end nailed	16d	2
Stud to sole plate, toe nail	3d	3 or 2 16d
Doubled studs, face nail	16d	24 inches o.c.
Doubled top plates, face nail	16d	16 inches o.c.
Top plates, laps and intersections, face nail	16d	2
Continuous header, two pieces	16	16 inches o.c. along each edge
Ceiling joists to plate, toe nail	16d	2
Continuous header to stud, toe nail	16d	3
Ceiling joists, laps over partitions, face nail	16d	3
Ceiling joists to parallel rafters, face nail	16d	3
Rafter plate, toe nail	16d	3
1 inch × 6 inch sheathing or less, to each bearing, face nail	8d	2
Over 1 inch × 6 inch sheathing, to each bearing, face nail	8d	3 + 1 for each size increase
Built-up corner studs, face nail	16d	30 inches o.c.
Built-up girders and beams	20d	32 inches o.c. At top and bottom and staggered, 2 at ends and at each splice
2-inch planks	16d	2 each bearing

For SI: 1 inch = 25.4 mm.

**NOTE:** In spacing specifications, o.c. means "on-center."

**2324.4** Except for wood-based structural-use panels and other laminated members manufactured under technical control and rigid inspection, gluing shall not be considered an acceptable connector in lieu of the connectors herein specified.

**2324.5** Safe loads and design practice for types of connectors not mentioned or fully covered herein shall be determined by the building official before approval.

### SECTION 2325 HIGH-VELOCITY HURRICANE ZONES—WOOD SUPPORTING MASONRY

**2325.1** Wood shall not support masonry or concrete except as permitted in Sections 2325.2 and 2325.3.

**2325.2** Wood foundation piles may be used to support concrete or masonry.

**2325.3** Plywood decking and approved wood panels, wood joists and wood studs supporting such wood joists may be used to support reinforced concrete slabs, concrete-base tile and terrazzo floors and lightweight concrete toppings as follows:

1. There shall be an approved moisture vapor barrier between the concrete or other cementitious materials and the wood.
2. Wood members supporting concrete shall be preservative treated in compliance with AWPA Use Category Systems Standard U1, Commodity Specification A Use Category 4B set forth in Sections 2314.4 and 2326.
3. Approved wood-based structural-use panel decking shall be rated for Exposure 1.
4. Wood rafters may support concrete roof tile.

### SECTION 2326 HIGH-VELOCITY HURRICANE ZONES — PROTECTION OF WOOD

**2326.1** Wood piles shall be treated with preservatives as set forth in Section 1823.1.2.

#### **2326.2 Preservative treated or durable species wood.**

**2326.2.1** All wood used in areas of building or structures where the climatic condition is conducive to deterioration which would affect the structural safety shall be treated in an approved method with an approved preservative or shall be of an approved durable species.

**2326.2.2** All wood in contact with or embedded in the ground that supports permanent structures shall be approved pressure-treated wood suitable for ground contact use.

#### **Exceptions:**

1. Naturally durable wood or pressure-treated wood may be used in contact with the ground for support of structures other than buildings and walking surfaces.
2. Untreated wood may be used for supports where entirely below water level and continuously submerged in fresh water.

**2326.2.3** Sleepers and sills on concrete slabs in contact with the ground, wood joists and the underside of wood structural floors without joists less than 18 inches (457 mm) above ground; or wood girders less than 12 inches (305 mm) from exposed ground within the crawl space under buildings, shall be treated in an approved method with an

approved preservative, or shall be of an approved durable species.

**2326.2.4** All wood not separated from and/or in direct contact with concrete masonry, including sills, sleepers, plates, posts, columns, beams, girders and furring; shall be treated in an approved method with and approved preservative, or shall be of an approved durable species.

**2326.2.5** The expression “pressure treated wood” refers to wood meeting the retention, penetration and other requirements applicable to the species, product, treatment and conditions of use in the approved standards of the American Wood Preservers Association (AWPA), Quality Control Program for Softwood Lumber, Timber and Plywood Pressure Treated with Water-borne Preservatives for Ground Contact Use in Residential and Light Commercial Foundations for the American Wood Preservers Bureau.

**2326.2.6** The expression “durable wood” refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood may be included if 90 percent or more of the width of each side on which it occurs is heartwood:

Decay resistant: Redwood, Cedars, Black Locust.

Termite resistant: Redwood, Bald and Eastern Red Cedar.

**2326.2.7** Where durable species of wood are used as structural members in buildings and structures, the stress grade shall be not less than that required in Section 2317.

**2326.2.8** When wood pressure treated with a waterborne preservative is used in enclosed locations where drying in service cannot readily occur, such wood shall have a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other material.

**2326.2.9** All wood framing less than 8 inches (203 mm) from exposed earth in exterior walls that rest on concrete or masonry foundations shall be of an approved naturally durable species or pressure treated wood.

**2326.2.10** All posts, poles and columns embedded in concrete, which is in contact with ground and supporting permanent structures, shall be approved pressure treated wood suitable for ground contact use; except naturally durable wood may be used for posts, poles and columns embedded in concrete for structures other than buildings and walking surfaces or in structures where wood is above ground level and not exposed to the weather.

**2326.2.11** For conditions not specifically covered, compliance with American Forest & Paper Product Association Wood Construction Data #6 “Design of Wood Frame Structures for Permanence” shall be deemed as compliance with this code.

### 2326.3 Ventilation.

**2326.3.1 Ventilation of crawl spaces.** Crawl spaces under buildings without basements shall be ventilated by approved mechanical means or by openings in foundation walls. Ventilation openings shall be covered with a corrosion-resistant wire mesh with openings not greater than  $\frac{1}{16}$ -inch (1.6 mm).

**2326.3.1.1** Where practicable, ventilating openings shall be arranged on three sides.

**2326.3.1.2** The minimum total area of ventilating openings shall be 2 square feet (0.19 m<sup>2</sup>) for each 15 linear feet (4.6 m) or a fraction thereof of exterior wall. Such opening need not be placed in the front of the building. Where mechanical ventilation is used, the ventilation rate shall be at least six air changes per hour.

**2326.3.2 Ventilation of attic spaces.** Attic space between ceiling joists and roof rafters shall be effectively cross-ventilated by approved mechanical means or with vent openings. The ratio of total net free ventilating area to the area of the ceiling shall be not less than  $\frac{1}{150}$ .

**Exception:** The venting ratio may be reduced to  $\frac{1}{300}$  where at least 50 percent of the installed ventilating area is provided by a ventilation system located in the upper portion of the space to be ventilated [within 18 inches (457 mm) of ridge]. The balance of the required ventilation shall be provided by eave or cornice vents.

**2326.3.2.1** Where practical, ventilating openings shall be arranged on three sides.

**2326.3.2.2** Where mechanical ventilation is used, the ventilation rate shall be at least six air changes per hour.

**2326.3.2.3** All openings into the attic space of any habitable building shall be covered with screening, hardware cloth or equivalent to prevent the entry of birds, squirrels, rodents, etc. The openings therein shall not exceed  $\frac{1}{8}$ -inch (3.2 mm).

**2326.3.2.4** For existing structures that were built before 1992 without soffit ventilation, and where in the opinion of the building official the soffit ventilation would be impossible or impractical to install, the building official may determine the extent to which the existing structure shall be made to conform to the requirements of this section.

### 2326.4 Debris.

**2326.4.1** Before any new building is erected, all stumps and roots shall be removed from the soil to a depth of at least 12 inches (305 mm) below the surface of the ground in the area to be occupied by the building.

**2326.4.2** In buildings or portions thereof having wood first-floor systems, all wood forms which have been used in placing concrete, if within the ground or less than 18 inches (457 mm) above the ground, shall be removed before the building is occupied or used for any purpose.

**2326.4.3** Loose or casual wood shall not be stored in direct contact with the ground under any building, and this space must be thoroughly cleaned of all wood and debris.

**2326.5 Termite protection.** All buildings shall have a pre-construction treatment protection against subterranean termites. The rules and laws as established by the Florida Department of Agriculture and Consumer Services shall be deemed as approved with respect to pre-construction soil treatment for protection against subterranean termites. A certificate of compliance shall be issued to the building department by the

licensed pest control company that contains the following statement: “The building has received a complete treatment for the prevention of subterranean termites. Treatment is in accordance with rules and laws established by the Florida Department of Agriculture and Consumer Services.”

**2326.6 Existing buildings.** Whenever the building official has knowledge of the existence of termites in any building or structure, he shall notify the owner in writing and direct that necessary measures be taken for the extermination of the termites within a reasonable length of time, not to exceed 60 days.

**2326.6.1** The building official shall inspect existing buildings having wood-stud exterior walls for which application for a permit for exterior wall coverings is made and shall have the authority to order the uncovering of structural elements for inspection and to require necessary repairs as a part of such approval for a permit, or may order demolition.

### SECTION 2327 HIGH-VELOCITY HURRICANE ZONES—FIRE RETARDANT WOOD

**2327.1** Fire-retardant-treated wood shall be defined as any wood product which, when impregnated with chemicals by a pressure process, or other means during manufacture, shall have, when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, a flame spread index 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 feet (3 m) beyond the centerline of the burner at any time during the test.

**2327.2** The allowable unit stresses for fire-retardant-treated wood, including fastener values, shall be developed from an approved method which considers the effects of anticipated temperatures and humidity to which the fire-retardant wood will be subjected, the type of treatment, and the redrying process.

**2327.3** All fire-retardant-treated wood shall bear an identification mark showing the flame spread classification thereof issued by an approved agency having a reexamination service which maintains a continued supervision and inspection over method of drying. If intended for exterior use, the wood shall be further identified to indicate suitability for exposure to the weather, as defined in Section 2327.5.

**2327.4** Where fire-retardant-treated wood is exposed to the weather, it shall be further identified to indicate that there is no increase in the listed flamespread classification as defined in Section 2322.1 when subjected to ASTM D 2898, *Standard Method for Accelerated Weathering of Fire Retardant Treated Wood for Fire Testing*.

**2327.5** Where experience has demonstrated a specific need for use of material of low hygroscopicity, fire-retardant-treated wood to be subjected to high humidity conditions shall be identified as 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.

**2327.6** Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for plywood before use. The identification mark shall show the method of drying after treatment. When fire-retardant-treated wood is air dried after treatment (ADAT) it shall be protected so that no leaching of chemicals will occur. Fire-retardant-treated wood kiln dried after treatment (KDAT) shall not be exposed to a dry bulb temperature exceeding 160°F (71°C). If required for curing, exterior fire-retardant-treated wood can be exposed to elevated temperatures when the moisture content of the wood does not exceed 19 percent for lumber or 15 percent for wood structural panels. The curing time shall not exceed 48 hours and the temperature shall not exceed 210°F (99°C).

### SECTION 2328 HIGH-VELOCITY HURRICANE ZONES—WOOD FENCES

**2328.1** Wood fences, so located on a property that by zoning regulations they cannot be used as a wall of a building, shall be constructed to meet the minimum specifications in Sections 2328.2 and 2328.3.

**2328.2** Fences not exceeding 6 feet (1829 mm) in height, shall be constructed to meet the following minimum requirements: from nominal 4 inch by 4 inch by 8 feet long (102 mm by 102 mm by 2438 mm) posts No. 2 grade or better spaced 4 feet (1219 mm) on center, and embedded 2 feet (610 mm) into a concrete footing 10 inches (254 mm) in diameter and 2 feet (610 mm) deep.

**2328.3** Fences not exceeding 5 feet (1524 mm) or 4 feet (1219 mm) in height shall be constructed as provided in Section 2328.2, except that the spacing of posts may be increased to 5 feet (1524 mm) and 6 feet (1829 mm) on center for these heights, respectively.

### SECTION 2329 HIGH-VELOCITY HURRICANE ZONES— FIRE-RETARDANT-TREATED SHAKES AND SHINGLES

**2329.1** Treated shakes and shingles, when impregnated with chemicals by the full-cell vacuum pressure process, shall be considered fire retardant (classified) roof coverings when tested in accordance with ASTM E 108, *Fire Tests of Roof Coverings*, including the rain test, ASTM D 2898, *Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing*. The fire-resistance tests shall include the intermittent flame test, spread of flame test, burning brand test and flying brand test. In addition, at the conclusion of the rain test, test panels shall be subjected to intermittent flame test, burning brand test and flying brand test.

**2329.2** Each bundle of fire-retardant-treated shakes and shingles shall be identified with labels indicating the manufacturer, the classification of the material (Class B) and the quality control agency.



**SECTION 2330  
HIGH-VELOCITY HURRICANE ZONES—WOOD  
BLOCKING**

**2330.1 General.**

**2330.1.1** Blocking is defined as wood pieces attached to the roof deck or to each other for the purpose of securing roof membrane or accessories.

**2330.1.2** Wood blocking attachment for buildings greater than 40 feet (12.2 m) in height must be designed by a registered architect or professional engineer.

**2330.1.3** Wood blocking attachment for lightweight insulating concrete, gypsum concrete, cementitious wood fiber and cellular concrete decks shall be designed by a registered architect or professional engineer. The decks themselves shall not be used as a wood blocking attachment substrate.

**2330.1.4** Wood blocking shall not be less than nominal 2 inches by 6 inches (51 mm by mm). The maximum unsupported overhang shall be 2 inches (51 mm). When the maximum overhang is employed, a nominal 2-inch by 6-inch (51 mm by mm) blocking shall be installed.

**2330.1.5** In recover applications, wood blocking may be reduced to nominal 1 inch (25 mm), providing the attachment is secured in compliance with this code.

**2330.1.6** Sound wood blocking may be reused in a recover or reroof application, providing the attachment is secured in compliance with the requirements of this code.

**2330.1.7** A fastener shall be placed within 3 inches (761 mm) of the end of each section of wood blocking and a 1/4-inch (6 mm) gap shall be left between each section of wood blocking. No piece of wood shall have less than two fasteners.

**2330.1.8** Fasteners other than nails shall be predrilled prior to attachment and countersunk to be flush with the surface of the wood blocking.

**2330.1.9** Wood shall be protected according to Section 2326.

**2330.1.10** Powder actuated fasteners shall not be used in wood blocking attachment.

**2330.2 Attachment to masonry block and concrete.**

**2330.2.1** Prior to the installation of wood blocking to standard weight masonry block, the two top courses shall be solidly filled with concrete or a tie beam shall be provided as required by this code.

**2330.2.2** The fastener's average withdrawal resistance per lineal foot shall be not less than 250 pounds per foot (3649 N/m) after the application of a 4:1 safety factor.

**2330.2.3** The pullover value of the proposed fastener through the wood blocking shall be not less than 125 percent of the design load of the proposed fastener. If less, a larger bearing washer shall be added to the fastener assembly to meet this requirement. Wood blocking thickness shall be not less than 1 1/2 inch (38 mm) if a bearing washer is required.

