

CHAPTER 5

FLOORS

SECTION R501 GENERAL

R501.1 Application. The provisions of this chapter shall control the design and construction of the floors for all buildings including the floors of *attic* spaces used to house mechanical or plumbing fixtures and *equipment*.

Exception: Buildings and structures located within the High-Velocity Hurricane Zone shall comply with the provisions of Chapter 44.

R501.2 Requirements. Floor construction shall be capable of accommodating all loads according to Section R301 and of transmitting the resulting loads to the supporting structural elements.

SECTION R502 WOOD FLOOR FRAMING

R502.1 General Requirements. Floor framing of light-frame wood construction shall be in accordance with the provisions of this Section.

R502.1.1 [IRC 502.1] Identification. Load-bearing dimension lumber for joists, beams and girders shall be identified by a *grade mark* of a lumber grading or inspection agency that has been *approved* by an accreditation body that complies with DOC PS 20. In lieu of a *grade mark*, a certificate of inspection issued by a lumber grading or inspection agency meeting the requirements of this section shall be accepted.

R502.1.1.1 [IRC 502.1.1] Preservative-treated lumber. Preservative treated dimension lumber shall also be identified as required by Section R317.2.

R502.1.1.2 [IRC 502.1.2] Blocking and subflooring. Blocking shall be a minimum of utility grade lumber. Subflooring may be a minimum of utility grade lumber or No. 4 common grade boards.

R502.1.1.3 [IRC 502.1.3] End-jointed lumber. *Approved* end-jointed lumber identified by a *grade mark* conforming to Section R502.1.1 may be used interchangeably with solid-sawn members of the same species and grade.

R502.1.1.4 [IRC 502.1.4] 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.

R502.1.1.5 [IRC 502.1.5] Structural glued laminated timbers. Glued laminated timbers shall be manufactured and identified as required in ANSI/AITC A190.1 and ASTM D 3737.

R502.1.1.6 [IRC 502.1.6] 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 to be accepted.

R502.1.1.7 [IRC 502.1.7] Exterior wood/plastic composite deck boards. Wood/plastic composites used in exterior deck boards shall comply with the provisions of Section R317.4.

R502.1.2 [IRC 502.12] Draftstopping required. Draftstopping shall be provided in accordance with Section R302.12.

R502.1.2.1 [IRC 502.13] Fireblocking required. Fireblocking shall be provided in accordance with Section R302.11.

R502.1.3 Wood trusses.

R502.1.3.1 [IRC 502.11.1] Design. Wood trusses shall be designed in accordance with *approved* engineering practice. The design and manufacture of metal plate connected wood trusses shall comply with ANSI/TPI 1. The truss design drawings shall be prepared by a registered professional where required by *Florida Statutes*.

R502.1.3.2 [IRC 502.1.3.2] Bracing. Trusses shall be braced to prevent rotation and provide lateral stability in accordance with the requirements specified in the *construction documents* for the building and on the individual truss design drawings. In the absence of specific bracing requirements, trusses shall be braced in accordance with the TPI/WTCA BCSI.

R502.1.3.3 [IRC 502.11.4] Alterations to trusses. Truss members and components shall not be cut, notched, spliced or otherwise altered in any way without the approval of a registered *design professional*. *Alterations* resulting in the addition of load (e.g., HVAC *equipment*, water heater, etc.), that exceed the design load for the truss, shall not be permitted without verification that the truss is capable of supporting the additional loading.

R502.1.3.4 [IRC 502.11.4] Truss design drawings. Truss design drawings, prepared in compliance with Section R502.1.3.1, shall be submitted to the *building official* and *approved* prior to installation. Truss design drawings shall 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.
3. Required bearing widths.
4. Design loads as applicable:

- 4.1. Top chord live load;
- 4.2. Top chord dead load;
- 4.3. Bottom chord live load;
- 4.4. Bottom chord dead load;
- 4.5. Concentrated loads and their points of application; and
- 4.6. Controlling wind loads.
- 5. Adjustments to lumber and joint connector design values for conditions of use.
- 6. Each reaction force and direction.
- 7. Joint connector type and description, e.g., size, thickness or gauge, and the dimensioned location of each joint connector except where symmetrically located relative to the joint interface.
- 8. Lumber size, species and grade for each member.
- 9. Connection requirements for:
 - 9.1. Truss-to-girder-truss;
 - 9.2. Truss ply-to-ply; and
 - 9.3. Field splices.
- 10. Calculated deflection ratio and/or maximum description for live and total load.
- 11. Maximum axial compression forces in the truss members to enable the building designer to design the size, connections and anchorage of the permanent continuous lateral bracing. Forces shall be shown on the truss drawing or on supplemental documents.
- 12. Required permanent truss member bracing location.

R502.1.4 [IRC 502.2.2] Decks. Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads as applicable. Such attachment shall not be accomplished by the use of toenails or nails subject to withdrawal.

Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting. For decks with cantilevered framing members, connections to exterior walls or other framing members, shall be designed and constructed to resist uplift resulting from the full live load specified in Table R301.5 acting on the cantilevered portion of the deck.

R502.1.5 [IRC 502.8] Drilling and notching. Structural floor members shall not be cut, bored or notched in excess of the limitations specified in this section. See Figure R502.1.5.

R502.1.5.1 [IRC 502.8.1] Sawn lumber. Notches in solid lumber joists, rafters and beams shall not exceed one-sixth of the depth of the member, shall not be longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Notches at the ends of the member shall not exceed one-fourth the depth of the member. The tension side of members 4 inches (102 mm) or greater in nominal thickness shall not be notched except at the ends of the members. The

diameter of holes bored or cut into members shall not exceed one-third the depth of the member. Holes shall not be closer than 2 inches (51 mm) to the top or bottom of the member, or to any other hole located in the member. Where the member is also notched, the hole shall not be closer than 2 inches (51 mm) to the notch.

R502.1.5.2 [IRC 502.8.2] Engineered wood products. Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members or I-joists are prohibited 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*.

R502.2 Design and construction. Floor framing of light-frame wood construction shall be designed and constructed in accordance with the provisions of Section R301.2.1.1 or in accordance with the AF&PA NDS. Floor framing of light-frame wood construction shall also comply with Sections R319, R320, and R502.1.

Figure R502.2 Floor Construction. Reserved.

R502.2.1 Framing at braced wall lines. Reserved.

R502.2.2 Deck. [Moved to R502.1.4]

R502.2.2.1 Deck ledger connection to band joist. Reserved.

Table R502.2.2.1 Fastener Spacing For A Southern Pine or Hem-Fir Deck Ledger and a 2-inch Nominal Solid-Sawn Spruce-Pine-Fir Band Joist. Reserved.

R502.2.2.1.1 Placement of lag screws or bolts in deck ledgers. Reserved.

R502.2.2.2 Alternate deck ledger connections. Reserved.

R502.2.2.3 Deck lateral load connection. Reserved.

Figure R502.2.2.3 Deck Attachment For Lateral Loads. Reserved.

R502.2.2.4 Exterior wood/plastic composite deck boards. Reserved.

R502.3 Allowable joist spans. Reserved.

Table R502.3.1(1) Floor Joist Spans for Common Lumber Species. Reserved.

Table R502.3.1(2) Floor Joist Spans for Common Lumber Species. Reserved.

R502.3.1 Sleeping areas and attic joists. Reserved.

R502.3.2 Other floor joists. Reserved.

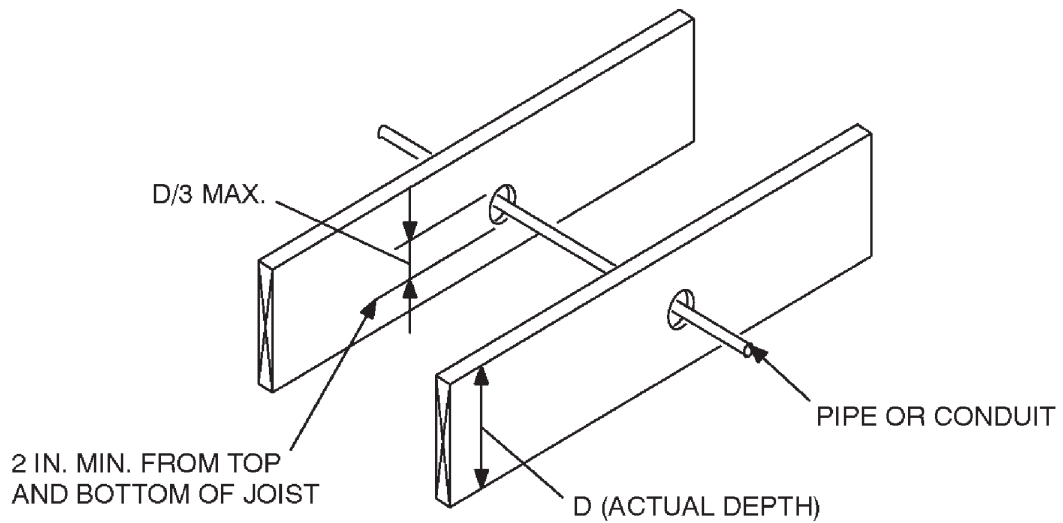
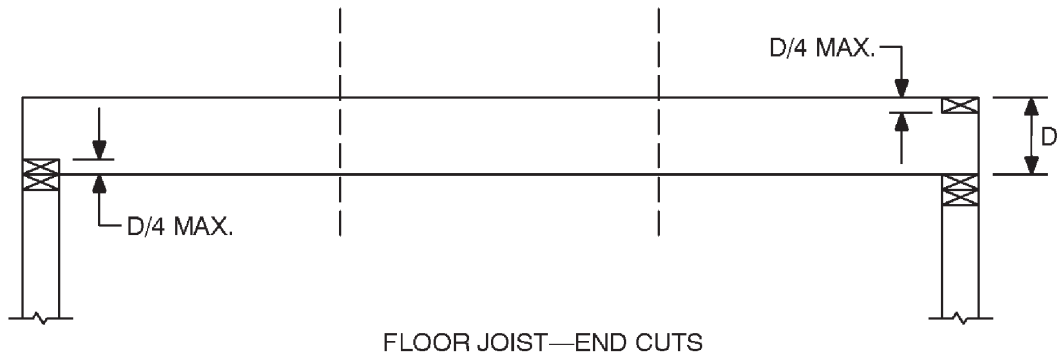
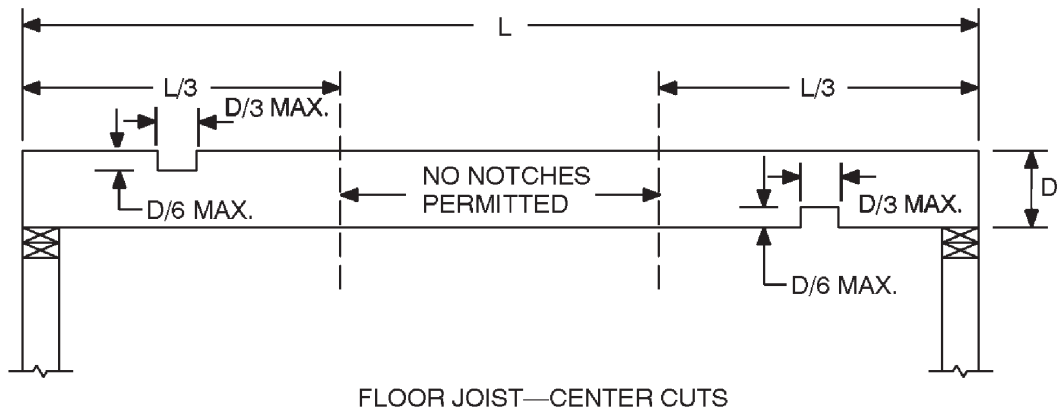
R502.3.3 Floor cantilevers. Reserved.

Table R502.3.3(1) Cantilever Spans for Floor Joists Supporting Light-Frame Exterior Bearing Wall and Roof Only. Reserved.

Table R502.3.3(2) Cantilever Spans For Floor Joists Supporting Exterior Balcony. Reserved.

R502.4 Joists under bearing partitions. Reserved.

R502.5 Allowable girder spans. Reserved.



For SI: 1 inch = 25.4 mm.

FIGURE R502.1.5
CUTTING, NOTCHING AND DRILLING

Table R502.5(1) Girder Spans and Header Spans for Exterior Bearing Walls. Reserved.

Table R502.5(2) Girder Spans and Header Spans for Interior Bearing Walls. Reserved.

R502.6 Bearing. Reserved.

R502.6.1 Floor systems. Reserved.

R502.6.2 Joist framing. Reserved.

R502.7 Lateral restraint at supports. Reserved.

R502.7.1 Bridging. Reserved.

R502.8 Drilling and notching. [Moved to R502.1.5]

Figure R502.8 Cutting, notching and drilling. [Moved to Figure R502.1.5]

R502.9 Fastening. Reserved.

R502.10 Framing of openings. Reserved.

R502.11 Wood trusses. Reserved.

R502.12 Draftstopping required. [Moved to R502.1.2]

R502.13 Fireblocking required. [Moved to R502.1.2.1]

**SECTION R503
FLOOR SHEATHING**

R503.1 Lumber sheathing. Maximum allowable spans for lumber used as floor sheathing shall conform to Tables R503.1, R503.2.1.1(1) and R503.2.1.1(2).

R503.1.1 End joints. End joints in lumber used as subflooring shall occur over supports unless end-matched lumber is used, in which case each piece shall bear on at least two joists. Subflooring may be omitted when joist spacing does not exceed 16 inches (406 mm) and a 1-inch (25.4 mm) nominal tongue-and-groove wood strip flooring is applied perpendicular to the joists.

**TABLE R503.1
MINIMUM THICKNESS OF LUMBER FLOOR SHEATHING**

| JOIST OR BEAM SPACING (inches) | MINIMUM NET THICKNESS | |
|--------------------------------|------------------------|-------------------|
| | Perpendicular to joist | Diagonal to joist |
| 24 | $1\frac{1}{16}$ | $\frac{3}{4}$ |
| 16 | $\frac{5}{8}$ | $\frac{5}{8}$ |
| 48 ^a | $1\frac{1}{2}$ T & G | N/A |
| 54 ^b | | |
| 60 ^c | | |

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa.

- a. For this support spacing, lumber sheathing shall have a minimum F_b of 675 and minimum E of 1,100,000 (see AF&PA/NDS).
- b. For this support spacing, lumber sheathing shall have a minimum F_b of 765 and minimum E of 1,400,000 (see AF&PA/NDS).
- c. For this support spacing, lumber sheathing shall have a minimum F_b of 855 and minimum E of 1,700,000 (see AF&PA/NDS).

R503.2 Wood structural panel sheathing.

R503.2.1 Identification and grade. Wood structural panel sheathing used for structural purposes shall conform to

DOC PS 1, DOC PS 2 or, when manufactured in Canada, CSA O437 or CSA O325. All panels shall be identified by a grade mark of certificate or inspection issued by an approved agency.

R503.2.1.1 Subfloor and combined subfloor underlayment. Where used as subflooring or combination subfloor underlayment, wood structural panels shall be of one of the grades specified in Table R503.2.1.1(1). When sanded plywood is used as combination subfloor underlayment, the grade shall be as specified in Table R503.2.1.1(2).

**TABLE R503.2.1.1(2)
ALLOWABLE SPANS FOR SANDED PLYWOOD
COMBINATION SUBFLOOR UNDERLAYMENT^a**

| IDENTIFICATION | SPACING OF JOISTS (inches) | | |
|----------------------------|----------------------------|---------------|---------------|
| | 16 | 20 | 24 |
| Species group ^b | — | — | — |
| 1 | $\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{3}{4}$ |
| 2, 3 | $\frac{5}{8}$ | $\frac{3}{4}$ | $\frac{7}{8}$ |
| 4 | $\frac{3}{4}$ | $\frac{7}{8}$ | 1 |

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

- a. Plywood continuous over two or more spans and face grain perpendicular to supports. Unsupported edges shall be tongue-and-groove or blocked except where nominal $\frac{1}{4}$ -inch-thick underlayment or $\frac{3}{4}$ -inch wood finish floor is used. Allowable uniform live load at maximum span based on deflection of $\frac{1}{360}$ of span is 100 psf.
- b. Applicable to all grades of sanded exterior-type plywood.

R503.2.2 Allowable spans. The maximum allowable span for wood structural panels used as subfloor or combination subfloor underlayment shall be as set forth in Table R503.2.1.1(1), or APA E30. The maximum span for sanded plywood combination subfloor underlayment shall be as set forth in Table R503.2.1.1(2).

R503.2.3 Installation. Wood structural panels used as subfloor or combination subfloor underlayment shall be attached to wood framing to cold-formed steel framing in accordance with the standards used for the design of the building as specified in Section R301.2.1.1.

R503.3 Particleboard.

R503.3.1 Identification and grade. Particleboard shall conform to ANSI A208.1 and shall be so identified by a grade mark or certificate of inspection issued by an approved agency.

R503.3.2 Floor underlayment. Particleboard floor underlayment shall conform to Type PBU and shall not be less than $\frac{1}{4}$ inch (6.4 mm) in thickness.

R503.3.3 Installation. Particleboard underlayment shall be installed in accordance with the recommendations of the manufacturer and attached to framing in accordance with the standards used for the design of the building as specified in Section R301.2.1.1.

TABLE R503.2.1.1(1)
ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANELS FOR ROOF
AND SUBFLOOR SHEATHING AND COMBINATION SUBFLOOR UNDERLAYMENT^{a, b, c}

| SPAN RATING | MINIMUM NOMINAL PANEL THICKNESS (inch) | ALLOWABLE LIVE LOAD (psf) ^{h, 1} | | MAXIMUM SPAN (inches) | | LOAD (pounds per square foot, at maximum span) | | MAXIMUM SPAN (inches) |
|--|--|---|-----------------|--------------------------------|----------------------|--|-----------|--|
| | | SPAN @ 16" o.c. | SPAN @ 24" o.c. | With edge support ^d | Without edge support | Total load | Live load | |
| Sheathing^e | | Roof^f | | | | | | Subfloor^j |
| 16/0 | 3/8 | 30 | — | 16 | 16 | 40 | 30 | 0 |
| 20/0 | 3/8 | 50 | — | 20 | 20 | 40 | 30 | 0 |
| 24/0 | 3/8 | 100 | 30 | 24 | 20 ^e | 40 | 30 | 0 |
| 24/16 | 7/16 | 100 | 40 | 24 | 24 | 50 | 40 | 16 |
| 32/16 | 15/32, 1/2 | 180 | 70 | 32 | 28 | 40 | 30 | 16 ^h |
| 40/20 | 19/32, 5/8 | 305 | 130 | 40 | 32 | 40 | 30 | 20 ^{h, i} |
| 48/24 | 23/32, 3/4 | — | 175 | 48 | 36 | 45 | 35 | 24 |
| 60/32 | 7/8 | — | 305 | 60 | 48 | 45 | 35 | 32 |
| Underlayment, C-C plugged, single floor^e | | Roof^f | | | | | | Combination subfloor underlayment^k |
| 16 o.c. | 19/32, 5/8 | 100 | 40 | 24 | 24 | 50 | 40 | 16 ⁱ |
| 20 o.c. | 19/32, 5/8 | 150 | 60 | 32 | 32 | 40 | 30 | 20 ^{i, j} |
| 24 o.c. | 23/32, 3/4 | 240 | 100 | 48 | 36 | 35 | 25 | 24 |
| 32 o.c. | 7/8 | — | 185 | 48 | 40 | 50 | 40 | 32 |
| 48 o.c. | 1 3/32, 1 1/8 | — | 290 | 60 | 48 | 50 | 40 | 48 |

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

- a. The allowable total loads were determined using a dead load of 10 psf. If the dead load exceeds 10 psf, then the live load shall be reduced accordingly.
- b. Panels continuous over two or more spans with long dimension (strength axis) perpendicular to supports. Spans shall be limited to values shown because of possible effect of concentrated loads.
- c. Applies to panels 24 inches or wider.
- d. Lumber blocking, panel edge clips (one midway between each support, except two equally spaced between supports when span is 48 inches), tongue-and-groove panel edges, or other approved type of edge support.
- e. Includes Structural 1 panels in these grades.
- f. Uniform load deflection limitation: 1/180 of span under live load plus dead load, 1/240 of span under live load only.
- g. Maximum span 24 inches for 15/32- and 1/2-inch panels.
- h. Maximum span 24 inches where 3/4-inch wood finish flooring is installed at right angles to joists.
- i. Maximum span 24 inches where 1.5 inches of lightweight concrete or approved cellular concrete is placed over the subfloor.
- j. Unsupported edges shall have tongue-and-groove joints or shall be supported with blocking unless minimum nominal 1/4-inch thick underlayment with end and edge joints offset at least 2 inches or 1.5 inches of lightweight concrete or approved cellular concrete is placed over the subfloor, or 3/4-inch wood finish flooring is installed at right angles to the supports. Allowable uniform live load at maximum span, based on deflection of 1/360 of span, is 100 psf.
- k. Unsupported edges shall have tongue-and-groove joints or shall be supported by blocking unless nominal 1/4-inch-thick underlayment with end and edge joints offset at least 2 inches or 3/4-inch wood finish flooring is installed at right angles to the supports. Allowable uniform live load at maximum span, based on deflection of 1/360 of span, is 100 psf, except panels with a span rating of 48 on center are limited to 65 psf total uniform load at maximum span.
- l. Allowable live load values at spans of 16" o.c. and 24" o.c taken from reference standard APA E30, APA Engineered Wood Construction Guide. Refer to reference standard for allowable spans not listed in the table.

SECTION R504 PRESSURE PRESERVATIVELY TREATED-WOOD FLOORS (ON GROUND)

R504.1 General. Pressure preservatively treated-wood *basement* floors and floors on ground shall be designed to withstand axial forces and bending moments resulting from lateral soil pressures at the base of the exterior walls and floor live and dead loads. Floor framing shall be designed to meet joist deflection requirements in accordance with Section R301.

R504.1.1 Unbalanced soil loads. Unless special provision is made to resist sliding caused by unbalanced lateral soil loads, wood *basement* floors shall be limited to applications where the differential depth of fill on opposite exterior foundation walls is 2 feet (610 mm) or less.

R504.1.2 Construction. Joists in wood *basement* floors shall bear tightly against the narrow face of studs in the foundation wall or directly against a band joist that bears on the studs. Plywood subfloor shall be continuous over lapped joists or over butt joints between in-line joists. Sufficient blocking shall be provided between joists to transfer lateral forces at the base of the end walls into the floor system.

R504.1.3 Uplift and buckling. Where required, resistance to uplift or restraint against buckling shall be provided by interior bearing walls or properly designed stub walls anchored in the supporting soil below.

R504.2 Site preparation. The area within the foundation walls shall have all vegetation, topsoil and foreign material removed, and any fill material that is added shall be free of vegetation and foreign material. The fill shall be compacted to assure uniform support of the pressure preservatively treated-wood floor sleepers.

R504.2.1 Base. A minimum 4-inch-thick (102 mm) granular base of gravel having a maximum size of $3/4$ inch (19.1 mm) or crushed stone having a maximum size of $1/2$ inch (12.7 mm) shall be placed over the compacted earth.

R504.2.2 Moisture barrier. Polyethylene sheeting of minimum 6-mil (0.15 mm) thickness shall be placed over the granular base. Joints shall be lapped 6 inches (152 mm) and left unsealed. The polyethylene membrane shall be placed over the pressure preservatively treated-wood sleepers and shall not extend beneath the footing plates of the exterior walls.

R504.3 Materials. All framing materials, including sleepers, joists, blocking and plywood subflooring, shall be pressure-preservative treated and dried after treatment in accordance with AWP A U1 (Commodity Specification A, Use Category 4B and section 5.2), and shall bear the *label* of an accredited agency.

SECTION R505 STEEL FLOOR FRAMING RESERVED

SECTION R506 CONCRETE FLOORS (ON GROUND)

R506.1 General. Concrete slab-on-ground floors shall be a minimum 3.5 inches (89 mm) thick (for expansive soils, see Section R403.1.8). The specified compressive strength of concrete shall be as set forth in Section R402.2.

R506.2 Site preparation. The area within the foundation walls shall have all vegetation, top soil and foreign material removed.

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

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

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

R506.2.3 Vapor retarder. A 6 mil (0.006 inch; 152 μ m) polyethylene or *approved* vapor retarder with joints lapped not less than 6 inches (152 mm) shall be placed between the concrete floor slab and the base course or the prepared subgrade where no base course exists.

Exception: The vapor retarder may be omitted:

1. From detached garages, utility buildings and other unheated *accessory structures*.
2. For unheated storage rooms having an area of less than 70 square feet (6.5 m²) and carports.
3. From driveways, walks, patios and other flatwork not likely to be enclosed and heated at a later date.
4. Where *approved* by the *building official*, based on local site conditions.

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

R506.2.5 Joints. Concrete slabs on ground shall be provided with joints in accordance with ACI 224.3R or other approved methods. Joints shall be designed by an architect or engineer.

Exception: Joints are not required in unreinforced plain concrete slabs on ground or in slabs for one- and two-family dwellings complying with one of the following:

1. Concrete slabs on ground containing synthetic fiber reinforcement. Fiber lengths and dosage amounts shall comply with one of the following

- (1) Fiber lengths shall be $\frac{1}{2}$ inch to 2 inches (13 to 51 mm) in length. Dosage amounts shall be from 0.75 to 1.5 pounds per cubic yard (0.45 to 0.89 kg/m³) in accordance with the manufacturer's recommendations. Synthetic fibers shall comply with ASTM C 1116. The manufacturer or supplier shall provide certification of compliance with ASTM C 1116 when requested by the building official; or,
 - (2) Fiber length shall be from $\frac{1}{2}$ inch to 2 inches (13 mm to 51 mm) in length, monofilament or fibrillated. Dosage amounts shall be from 0.5 to 1.5 pounds per cubic yard (0.30 to 0.89 kg/m³) to achieve minimum 40 percent reduction of plastic shrinkage cracking of concrete versus a control mix in accordance with ICBO AC32. Independent test results using minimum six (6) test specimens shall be provided to the building official showing compliance with ICBO A32. Synthetic fiber shall comply with ASTM C 1116, Paragraph 4.1.3, Type III. The manufacturer or supplier shall provide certification of compliance with ASTM C 1116 when requested by the building official.
2. Concrete slabs on ground containing 6 × 6 W1.4 × W1.4 welded wire reinforcement fabric located in the middle to the upper one-third of the slab. Welded wire reinforcement fabric shall be supported with approved materials or supports at spacings not to exceed 3 feet (914 mm) or in accordance with the manufacturer's specifications. Welded plain wire reinforcement fabric for concrete shall conform to ASTM A 185, *Standard Specification for Steel Welded Wire Reinforcement Fabric, Plain, for Concrete Reinforcement*.

