

3.1 General Provisions

3.1.1 Prescriptive Requirements

The provisions of this Chapter establish a specific set of resistance requirements for buildings meeting the scope of this document (see 1.1). Tabular wind load requirements are based on Exposure B; buildings located in Exposure C shall be designed in accordance with Appendix A tables.

3.1.2 Equivalent Materials and Systems

The provisions of this Chapter are not intended to preclude the use of other methods or materials of construction. When alternative methods or materials are used, design loads and capacities shall be determined from the provisions of Chapter 2.

3.1.3 Prescriptive Design Limitations

Wood-frame buildings built in accordance with Chapter 3 of this document shall be limited to all of the following conditions. Conditions not complying with Chapter 3 of this document shall be designed in accordance with accepted engineering practice in accordance with Chapter 2.

3.1.3.1 Building Height

The building shall not exceed three stories nor a mean roof height of 33 feet, measured from average grade to average roof elevation. For purposes of determining uplift, gravity loads, and lateral bracing requirements, the attic shall be considered an additional story when the roof slope is greater than 6 in 12 (see Figure 3.1a).

3.1.3.2 Floor Systems

a. Framing Member Spans Single spans of floor framing members shall not exceed 26 feet for lumber joists.

b. Framing Member Spacings Floor framing member spacings shall not exceed 24 inches on center for lumber joists, I-joists, and floor trusses.

c. Cantilevers Lumber floor joist cantilevers supporting loadbearing walls or shearwalls shall not exceed the depth, d , of the joists (see Figure 2.1a). Lumber floor joist cantilevers supporting non-loadbearing walls which

are not shearwalls shall be limited to $L/4$ (see Figure 2.1b). Lumber joists shall be located directly over studs when used in cantilever conditions.

EXCEPTIONS:

1. For roof live loads and ground snow loads less than or equal to 20 psf and 30 psf, respectively, lumber floor joist cantilevers supporting loadbearing walls shall not exceed one-eighth of the backspan when supporting only a roof load where the roof clear span does not exceed 28 feet.

2. Lumber floor joist cantilevers supporting non-loadbearing walls which act as shearwalls shall not exceed four times the depth ($4d$) of the member when the following framing requirements are met:

- a. Floor joists are nominal 2 inches by 10 inches or larger and spaced not more than 16 inches on center;
- b. The cantilever shall not exceed half of the backspan;
- c. Floor joists at ends of shearwalls are doubled; and,
- d. End restraint is provided at the ends of cantilevers.

d. Setbacks Setbacks of loadbearing walls or shearwalls on lumber floor joist systems shall not exceed the depth, d , of the joists (see Figure 2.1d). Lumber floor joists shall be located directly over studs when used in setback conditions supporting loadbearing walls.

EXCEPTION: Setbacks of non-loadbearing shearwalls on lumber floor joist systems shall not exceed four times the depth ($4d$) of the member when the following framing requirements are met:

- a. Floor joists are nominal 2 inches by 10 inches or larger and spaced not more than 16 inches on center; and,
- b. Floor joists at ends of shearwalls are doubled.

e. Vertical Floor Offsets Vertical floor offsets shall be limited to the depth, d_p , (including floor framing mem-

bers and floor sheathing), and the floor framing members on each side of the offset shall be lapped or tied together to provide a direct tension tie across the offset, and to transfer diaphragm shear in both orthogonal directions (see Figure 1.2).

f. Diaphragm Aspect Ratio Floor diaphragm lengths shall be in accordance with Table 3.16B.

EXCEPTION: Allowable sidewall lengths provided in Table 3.16B shall be permitted to be modified when interior shearwalls are used. Sheathing and connections shall be in accordance with 3.4.4.2.

g. Diaphragm Openings Floor diaphragm openings shall not exceed the lesser of 12 feet or 50% of the building dimension (see Figure 1.4).

3.1.3.3 Wall Systems

a. Wall Heights Loadbearing walls shall not exceed 10 feet in height. Non-loadbearing walls shall not exceed 20 feet in height.

b. Wall Stud Spacings Wall stud spacings shall not exceed 24 inches on center.

c. Shearwall Line Offsets Offsets in a shearwall line within a story shall not exceed 4 feet (see Figure 1.5).

EXCEPTION: When shearwalls are discontinuous or shearwall line offsets exceed these limits, the structure shall be considered as separate structures attached in the plane of the offset. For wind design, the structure shall be permitted to be designed as a rectangular structure with perimeter dimensions which inscribe the total structure (see Figure 3.1b).

d. Shearwall Story Offsets Upper story shearwall segments shall not be offset from lower story shearwall segments by more than the depth, d , of the floor framing members (see Figure 1.6).

EXCEPTION: Shearwall segments shall be permitted to be offset from the story below when continuity of the loadpath to the resisting elements is designed and detailed in accordance with the governing building code.

e. Shearwall Segment Aspect Ratio Shearwall segment aspect ratios shall not exceed the limits in Table 3.17D (see Figure 1.7).

f. Shearwall Orientation Shearwall lines shall be oriented to resist loads in two orthogonal directions.

g. Load Transfer Band joists, blocking, or other methods to transfer roof, wall, and/or floor loads from upper stories shall be installed between floor framing members for 2 and 3 story structures (see Figures 3.4d and 3.5a).

3.1.3.4 Roof Systems

a. Framing Spans Single spans (horizontal projection) of roof framing members shall not exceed 26 feet for lumber rafters. The total roof span shall not exceed 36 feet.

b. Framing Spacings Roof framing member spacings shall not exceed 24 inches on center for lumber rafters, I-joists, and roof trusses.

c. Overhang Lengths Rafter overhang lengths shall not exceed one-third of the rafter span or 2 feet, whichever is less (see Figure 2.1f). Rake overhangs shall not exceed the lesser of one-half of the purlin length or 2 feet (see Figure 2.1g).

EXCEPTION: Rake overhangs using lookout blocks shall not exceed 1 foot (see Figure 2.1h).

d. Slope Roof slope shall not exceed 12:12.

e. Diaphragm Aspect Ratio Roof diaphragm lengths shall be in accordance with Table 3.16A.

EXCEPTION: Allowable sidewall lengths provided in Table 3.16A shall be permitted to be modified when interior shearwalls are used. Sheathing and connections shall be in accordance with 2.4.4.2.

3.1.4 Interpolation

Tabulated values in this Chapter shall be permitted to be interpolated unless otherwise noted in the applicable table footnotes.

3.2 Connections

3.2.1 Lateral Framing and Shear Connections

3.2.1.1 Roof Assembly

Roof framing connections shall be in accordance with the requirements of Table 3.1.

3.2.1.2 Roof Assembly to Wall Assembly

Lateral framing and shear connections for rafter, ceiling joist, or truss to top plate shall be in accordance with the requirements of Table 3.4. Prescriptive solutions are provided for lateral framing and shear connections in Table 3.4A.

3.2.1.3 Wall Assembly

Lateral framing connections for top and bottom plate to wall stud shall be in accordance with the requirements of Tables 3.5. Prescriptive solutions are provided for lateral framing connections in 3.5A. Other wall assembly lateral framing and shear connections shall be in accordance with the requirements of Table 3.1.

3.2.1.4 Wall Assembly to Floor Assembly

Lateral framing and shear connections for bottom plate to floor assembly shall be in accordance with the requirements of Table 3.1.

3.2.1.5 Floor Assembly

Floor framing connections shall be in accordance with the requirements of Table 3.1.

3.2.1.6 Floor Assembly to Wall Assembly or Sill Plate

Lateral framing and shear connections for floor assembly to sill, top plate, or girder shall be in accordance with the requirements of Table 3.1.

3.2.1.7 Wall Assembly or Sill Plate to Foundation

Sill plates or wall bottom plates shall be anchored to the foundation system to resist lateral and shear loads from wind in accordance with the requirements of Table 3.2. Prescriptive solutions are provided for sill plate to foundation in Table 3.2A, and for bottom plate to foundation in Table 3.2B. Sill plates or wall bottom plates shall be anchored to the foundation system to resist shear loads from seismic in accordance with the requirements of Table 3.3. Prescriptive solutions are provided for sill or bottom

plate to foundation in Table 3.3A. A minimum of one anchor bolt shall be provided within 6 to 12 inches of each end of each plate. Anchor bolts shall have a minimum embedment of 7 inches in concrete foundations and slabs-on-grade or 7 inches in masonry block foundations when resisting lateral and shear loads only (see Figures 3.2a-c). Anchor bolts shall be located within 12 inches of corners and at spacings specified in Tables 3.2A-B or Table 3.3A, but not exceeding 6 feet on center. Sill plates or bottom plates shall have full bearing on the foundation system.

3.2.2 Uplift Connections

3.2.2.1 Roof Assembly to Wall Assembly

Rafter or truss to wall stud uplift connections shall be in accordance with the requirements of Table 3.4. Prescriptive solutions are provided in Table 3.4B. When rafters or trusses are not located directly above studs, rafters or trusses shall be attached to the wall top plate and the wall top plate shall be attached to the wall stud with uplift connections in accordance with Table 3.4.

3.2.2.2 Wall Assembly to Wall Assembly

Story to story uplift connections from upper story wall stud to lower story wall stud shall be in accordance with the requirements of Table 3.4. Prescriptive solutions are provided in Table 3.4B. When upper story wall studs are not located directly above lower story wall studs, the studs shall be attached to a common member in the floor assembly with uplift connections in accordance with Table 3.4.

3.2.2.3 Wall Assembly to Foundation

First floor wall studs shall be connected to the foundation, sill plate, or bottom plate in accordance with the requirements of Table 3.2. Prescriptive solutions for stud to foundation, sill plate, or bottom plate are provided in Table 3.4B (see Figures 3.2a-e). A minimum of a 1¼"x20 gage ASTM A653 Grade 33 steel strap shall be nailed to the studs in accordance with Table 3.4B and have a minimum embedment of 7 inches in concrete foundations and slabs-on-grade, 15 inches in masonry block foundations, or be lapped under the plate and nailed in accordance with Table 3.4B (see Figures 3.2a-c). When the steel strap is lapped under the bottom plate, 3-inch square washers shall be used on the anchor bolts and anchor bolt spacings shall not exceed the requirements specified in Table 3.2C. Steel straps embedded in or in contact with slab-on-grade or

masonry block foundations shall be hot-dipped galvanized after fabrication, or manufactured from G185 or Z450 galvanized steel.

3.2.3 Overturning Resistance

3.2.3.1 Holddowns

Holddowns shall be installed in the shearwall in accordance with 3.4.4.2.3 (see Figures 3.8a-b). A continuous load path from the holddown to the foundation shall be maintained. Where a holddown resists the overturning load from the story or stories above, the holddown shall be sized for the required holddown tension capacity at its level plus the required holddown tension capacity of the story or stories above. For walls sheathed with materials other than those specified in 3.4.4.2, holddown tension capacity at each level shall equal the tabulated shear capacity in Table 3.17D times the wall height.

3.2.4 Sheathing and Cladding Attachment

3.2.4.1 Roof Sheathing

Roof sheathing attachment shall be in accordance with the minimum nailing requirements specified in Table 3.10.

3.2.4.2 Wall Sheathing

Wall sheathing attachment shall be in accordance with the minimum nailing requirements specified in Table 3.11.

3.2.4.3 Floor Sheathing

Floor sheathing shall be attached with a minimum of 8d common nails spaced at a maximum of 6 inches on center at panel edges and 12 inches on center in the panel field.

3.2.4.4 Roof Cladding

Roof cladding shall be attached in accordance with the manufacturer's recommendations.

3.2.4.5 Wall Cladding

Wall cladding shall be attached in accordance with the minimum nailing requirements in Table 3.11 or comply with the manufacturer's recommendations.

3.2.5 Special Connections

3.2.5.1 Ridge Straps

Ridge straps shall attach to opposing rafters in accordance with the requirements given in Table 3.6. Prescriptive solutions are provided in Table 3.6A.

EXCEPTION: Ridge straps are not required when collar ties (collar beams) of nominal 1x6 or 2x4 lumber are located in the upper third of the attic space and attached to rafters in accordance with Table 3.6A.

3.2.5.2 Jack Rafters

Jack rafters shall be attached to the wall assembly in accordance with 3.2.2.1 and attached to hip beams in accordance with Table 3.6.

3.2.5.3 Non-Loadbearing Wall Assemblies

Rake overhang-to-wall, wall-to-wall, and wall-to-foundation connections shall be in accordance with the requirements given in Table 3.4C (see Figures 2.1g-h). Walls which do not support the roof assembly and are attached in accordance with 3.2.1 need no additional uplift connections.

3.2.5.4 Connections around Wall Openings

3.2.5.4.1 Header and/or Girder to Stud Connections Headers and/or girder to stud connections shall be in accordance with the requirements given in Table 3.7. Window sill plate to stud connections shall be in accordance with the requirements given in Table 3.8.

3.2.5.4.2 Top and Bottom Plate to Full Height Studs When the number of full height studs required at each end of a header are selected from Table 3.23C, each stud shall be connected in accordance with the requirements given in Tables 3.5. Prescriptive solutions for top and bottom plate to stud connections are provided in Table 3.5A.

EXCEPTION: When the number of full height studs required at each end of a header are selected from Table 3.23D, the capacity of the connection of the top or bottom plate to each full height stud shall be equal to the unit lateral load, w (plf), given in Table 3.5 times half of the header span, $L/2$ (ft), divided by the required number of full height studs, NFH, selected from Table 3.23D.

Top or Bottom Plate to Each Full Height Stud Connection = $w * (L/2) / NFH$

3.3 Floor Systems

3.3.1 Wood Joist Systems

3.3.1.1 Floor Joists

Floor joists shall be in accordance with the maximum spans for common species and grades of lumber floor joists specified in Tables 3.18A-B.

3.3.1.1.1 Notching and Boring Notches in the top or bottom edge of solid-sawn joists shall not be located in the middle one-third of the joist span. Notches in the outer thirds of the span shall not exceed one-sixth of the actual joist depth, and shall not be longer than one-third of the depth of the member. Where notches are made at the supports, they shall not exceed one-fourth the actual joist depth. Bored holes are limited in diameter to one-third the actual joist depth and the edge of the hole shall not be closer than 2 inches to the top or bottom edge of the joist. Bored holes shall not be located closer than 2 inches to a notch (see Figure 3.3a).

3.3.1.2 Bearing

Joists shall bear directly on beams, girders, ledgers, or loadbearing walls or be supported by hangers. Joist bearing shall not be less than 1½ inches on wood or metal or 3 inches on masonry (see Figures 3.4a-e). Beams and girders shall bear on loadbearing walls, piles, concrete or masonry foundations, or beam hangers (see Figure 3.4f).

3.3.1.3 End Restraint

Restraint against twisting shall be provided at the end of each joist by fastening to a rim, band joist, header, or other member or by using full-height blocking between floor joist ends. Fasteners for end restraint shall be provided in accordance with Table 3.1 (see Figures 3.4a-e).

3.3.1.4 Lateral Stability

The following rules shall be applied to provide lateral restraint to prevent rotation or lateral displacement. If the ratio of depth to breadth, d/b , based on nominal dimensions is:

- (a) $d/b \leq 2$; no lateral support shall be required.
- (b) $2 < d/b \leq 4$; the ends shall be held in position, as by full depth solid blocking, bridging, hangers, nailing or bolting to other framing members, or other acceptable means.
- (c) $4 < d/b \leq 5$; the compression edge of the member shall be held in line for its entire length to prevent lateral displacement, as by adequate sheathing or subflooring, and ends at point of

bearing shall be held in position to prevent rotation and/or lateral displacement.

- (d) $5 < d/b \leq 6$; bridging, full depth solid blocking or diagonal cross bracing shall be installed at intervals not exceeding 8 feet, the compression edge of the member shall be held in line as by adequate sheathing or subflooring, and ends at point of bearing shall be held in position to prevent rotation and/or lateral displacement.
- (e) $6 < d/b \leq 7$; both edges of the member shall be held in line for their entire length and ends at points of bearing shall be held in position to prevent rotation and/or lateral displacement.

If a bending member is subjected to both flexure and axial compression, the depth to breadth ratio shall be permitted to be as much as 5 to 1 if one edge is firmly held in line. If under all combinations of load, the unbraced edge of the member is in tension, the depth to breadth ratio shall be permitted to be no more than 6 to 1.

3.3.1.5 Single or Continuous Floor Joists

3.3.1.5.1 Single or Continuous Floor Joists Supporting Loadbearing Walls Loadbearing walls parallel to joists shall be directly supported by beams, girders, or other loadbearing walls. Loadbearing walls perpendicular to joists shall not be offset from supporting girders, beams, or other loadbearing walls by more than the depth of the joists (see Figures 2.1d and 3.5a).

3.3.1.5.2 Single or Continuous Floor Joists Supporting Non-Loadbearing Walls Where non-loadbearing walls are parallel to floor joists, the joist supporting the non-loadbearing wall shall be doubled (see Figure 3.5b).

EXCEPTION: When the non-loadbearing wall is located between two floor joists, the floor joists need not be doubled. Solid blocking shall be installed at intervals not exceeding 32 inches on center to transfer the wall load to the supporting joists (see Figure 3.5c).

3.3.1.5.3 Single or Continuous Floor Joists Supporting Concentrated Loads Where concentrated loads exceeding 300 pounds must be supported by floor joists, the joist supporting the load shall be doubled (see Figure 3.5d).

3.3.1.6 Cantilevered Floor Joists

3.3.1.6.1 Cantilevered Floor Joists Supporting Loadbearing Walls Overhang lengths of cantilevered floor joists supporting a loadbearing wall at the end of the cantilever shall be limited to the depth of the joists (see Figure 2.1a).

EXCEPTION: For roof live loads and ground snow loads less than or equal to 20 psf and 30 psf, respectively, cantilevers shall not exceed one-eighth of the joist span for lumber joists supporting only a roof with a clear span of 28 feet or less. Lumber joists shall be located directly over studs when used in cantilever conditions supporting loadbearing walls (see Figure 2.1a).

3.3.1.6.2 Cantilevered Floor Joists Supporting Non-Loadbearing Walls Overhang lengths of cantilevered floor joists supporting a non-loadbearing wall at the end of the cantilever shall not exceed one-fourth of the joist span (see Figure 2.1b).

3.3.1.7 Floor Diaphragm Openings

Trimmers and headers shall be doubled when the header span exceeds 4 feet. Headers more than 6 feet in length shall be supported by joist hangers or framing anchors unless they bear on a partition, beam, or wall. Tail joists which exceed 12 feet in length shall be supported on framing anchors or on ledger strips not less than nominal 2x2 inches (see Figures 3.6a-b). Nailing requirements are given in Table 3.1.

3.3.2 Wood I-Joist Systems

Wood I-joist systems shall meet the requirements of 2.3.2.

3.4 Wall Systems

3.4.1 Exterior Walls

3.4.1.1 Wood Studs

Wall studs shall be in accordance with the maximum spans for common species and grades of wall studs specified in Tables 3.20A-B. Exterior loadbearing studs shall be limited to a height of 10 feet or less between horizontal supports.

3.4.1.1.1 Notching and Boring Notches in either edge of studs shall not be located in the middle one-third

3.3.3 Wood Floor Truss Systems

Wood floor truss systems shall meet the requirements of 2.3.3. See Table 3.19 for representative metal plate connected wood floor truss span tables. Actual design spans will vary by truss manufacturer as a result of specific design conditions.

3.3.4 Floor Sheathing

3.3.4.1 Sheathing Spans

Floor sheathing spans shall not exceed the provisions of Table 3.14.

3.3.4.2 Sheathing Edge Support

Edges of floor sheathing 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 installed, or unless the finish floor is of $\frac{3}{4}$ -inch wood strip.

3.3.5 Floor Diaphragm Bracing

For 3 second gust wind speeds greater than 100 mph, blocking and connections shall be provided at panel edges perpendicular to floor framing members in the first two bays of framing and shall be spaced at a maximum of 4 feet on center. Nailing requirements are given in Table 3.1 (see Figure 3.7b).

of the stud length. Notches in the outer thirds of the stud length shall not exceed 25% of the actual stud depth. Bored holes shall not exceed 40% of the actual stud depth and the edge of the hole shall not be closer than $\frac{5}{8}$ inch to the edge of the stud (see Figure 3.3b). Notches and holes shall not occur in the same cross-section.

EXCEPTION: Bored holes shall not exceed 60% of the actual stud depth when studs are doubled.