

## Chapter Comm 21

### CONSTRUCTION STANDARDS

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**Note:** Chapter Ind 21 was renumbered to be chapter ILHR 21, Register, February, 1985, No. 350, eff. 3-1-85. Chapter ILHR 21 was renumbered chapter Comm 21 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, January, 1999, No. 517.

#### Subchapter I — Scope

**Comm 21.01 Scope.** The provisions of this chapter shall apply to the design and construction of all one- and 2-family dwellings.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80.

#### Subchapter II — Design Criteria

**Comm 21.02 Loads and materials.** Every dwelling shall be designed and constructed in accordance with the requirements of this section.

(1) **DESIGN LOAD.** Every dwelling shall be designed and constructed to support the actual dead load, live loads and wind loads acting upon it without exceeding the allowable stresses of the material. The construction of buildings and structures shall result in a system that provides a complete load path capable of transferring all loads from point of origin through the load-resisting elements to the foundation.

(a) **Dead loads.** Every dwelling shall be designed and constructed to support the actual weight of all components and materials. Earth-sheltered dwellings shall be designed and constructed to support the actual weight of all soil loads.

(b) **Live loads.** 1. Floors and ceilings. Floors and ceilings shall be designed and constructed to support the minimum live loads listed in Table 21.02. The design load shall be applied uniformly over the component area.

**TABLE 21.02**

Component	Live Load (pounds per sq. ft.)
Floors . . . . .	40
Garage floors . . . . .	50
Exterior balconies, decks, porches . .	40
Ceilings (with storage) . . . . .	20
Ceilings (without storage) . . . . .	5

2. Snow loads. Roofs shall be designed and constructed to support the minimum snow loads listed on the zone map. The loads shall be assumed to act vertically over the roof area projected upon a horizontal plane.

(c) **Wind loads.** 1. Dwellings shall be designed and constructed to withstand a horizontal and uplift pressure of 20 pounds per square foot acting over the surface area.

2. Roof framing members spanning more than 6 feet measured from the outermost edge of the roof shall be permanently fastened to the top plate of load bearing walls using engineered clips, straps or hangers.

3. Roof framing members spanning 6 feet or less measured from the outermost edge of the roof shall be permanently fastened to the top plate of load bearing walls using toe-nailing, or engineered clips, straps or hangers.

**Note:** For information on toe-nailing, see the fastener schedule table in the appendix.

(d) **Fasteners.** All building components shall be fastened to withstand the dead load, live load and wind load.

**Note:** See the Appendix for a schedule of fasteners that will be acceptable to the department for compliance with this subsection. Other fastening methods may be allowed if engineered under s. Comm 21.02 (3).

(2) METHODS OF DESIGN. All dwellings shall be designed by the method of structural analysis or the method of accepted practice specified in each part of this code.

Note: See ch. NR 116, rules of the department of natural resources, for special requirements relating to buildings located in flood plain zones. Information regarding the elevation of the regional flood may be obtained from the local zoning official.

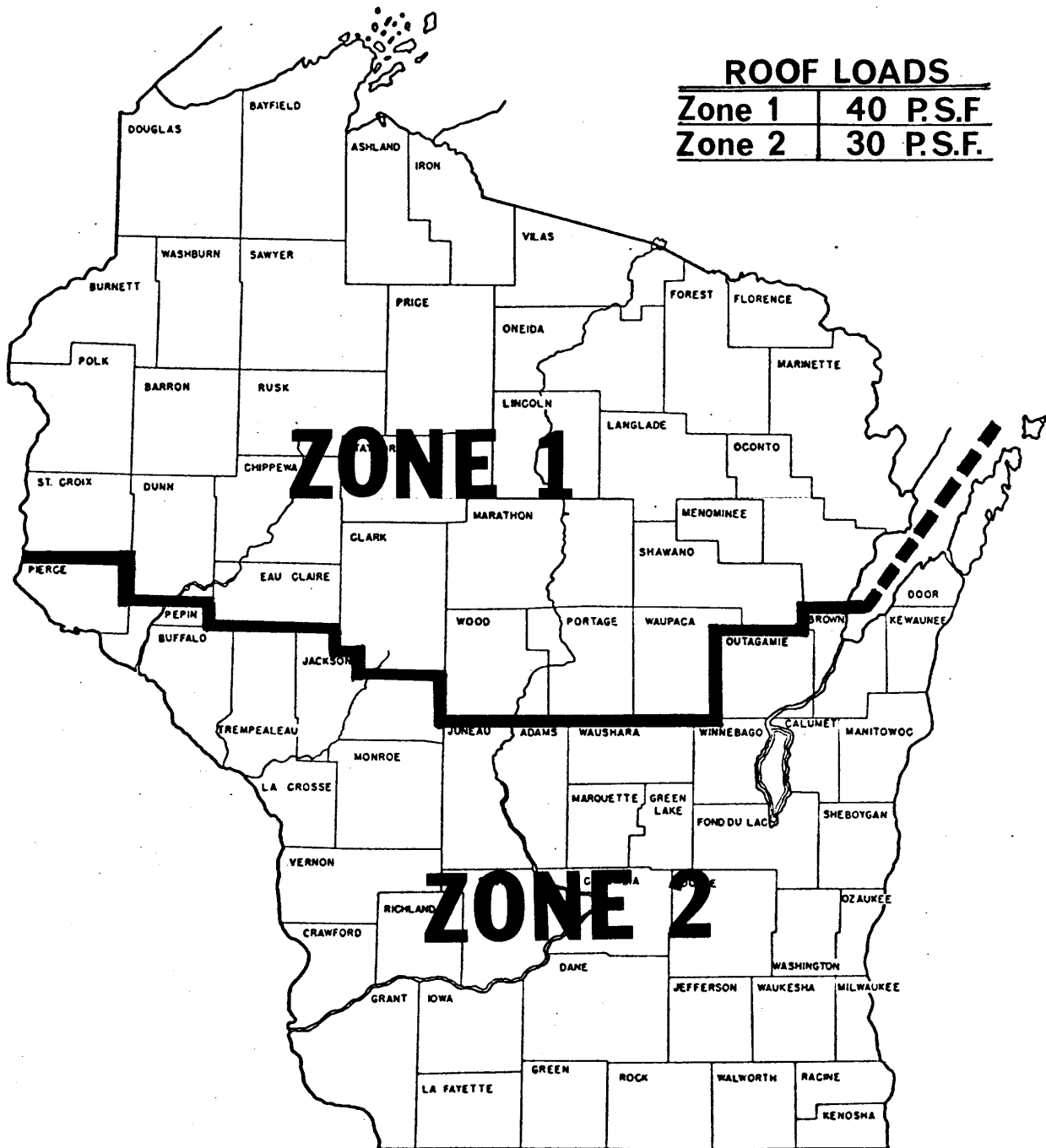
(3) STRUCTURAL ANALYSIS STANDARDS. Structural analysis

shall conform to the following nationally recognized standards.

(a) Wood. 1. Except as provided in subd. 1. a. and b., structural lumber, glue-laminated timber, timber pilings and fastenings shall be designed in accordance with the "National Design Specification for Wood Construction" and the "Design Values for Wood Construction," a supplement to the National Design Specification for Wood Construction.

Figure 21.02

ZONE MAP FOR ROOF LOADS



a. Section 2.2.5.3. The cumulative effects of short-time loads, such as snow, shall be considered in determining duration of load. For snow load, no greater duration of load factor than 1.15 shall be used.

b. Section 4.1.7. The provisions of this section shall also apply to reused lumber. Reused lumber shall be considered to have a duration of load factor of 0.90.

2. Span tables for joists and rafters printed in the appendix or approved by the department may be used in lieu of designing by structural analysis.

(b) *Structural steel*. The design, fabrication and erection of structural steel for buildings shall conform to Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design and the provisions of the accompanying commentary as adopted under Table 20.24-3.

(c) *Concrete*. Plain, reinforced or prestressed concrete construction shall conform to the following standards:

1. ACI Standard 318, "Building Code Requirements for Reinforced Concrete".

2. ACI Standard 318.1, "Building Code Requirements for Structural Plain Concrete".

(d) *Masonry*. The design and construction of masonry shall conform to the provisions of the Concrete Masonry Handbook for Architects, Engineers, Builders.

(e) *Engineered structural components*. Engineered structural components shall be used in accordance with structural analysis or with load tables supplied by the manufacturer, provided those load tables were developed using structural analysis or load testing.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. (3) (a), am. (3) (c) and Table 21.02, cr. (3) (c) 2., Register, February, 1985, No. 350, eff. 3-1-85; cr. (3) (a) 3., am. (3) (b), renum. (3) (e) to be (3) (d), and am., Register, November, 1995, No. 479, eff. 12-1-95; renum. and am. (1) (c) to be (1) (c) 1., cr. (1) (c) 2. and 3., am. (3) (d), Register, January, 1999, No. 517, eff. 2-1-99; r. (3) (a) 3. and cr. (3) (e), Register, March, 2001, No. 543, eff. 4-1-01; correction in (3) (b) made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 02-077: am. (1) (intro.) and (d) Register May 2003 No. 569, eff. 8-1-03; corrections in (3) (b) and (d) made under s. 13.93 (2m) (b) 7., Stats., Register May 2003 No. 569.

**Comm 21.03 Exits, doors and hallways.** Exits, doors and hallways shall be constructed as specified in this section.

(1) **EXITS FROM THE FIRST FLOOR.** (a) Except as allowed under par. (h), every dwelling unit shall be provided with at least 2 exit doors accessible from the first floor.

(b) At least one of the exits shall discharge to grade. This exit may include interior or exterior stairs.

(c) An additional exit may discharge to an outside balcony that complies with sub. (10).

(d) An additional exit may discharge into an attached garage provided the garage has an exit door that discharges to grade. An overhead garage door may not be used as an exit door.

(e) Except as allowed under pars. (f) and (h), the 2 required exit doors shall be separated by at least the greater of the following distances:

1. One-third the length of the longest diagonal of the floor in plan view, exclusive of an attached garage.
2. 20 feet.

**Note:** See appendix for examples of exit separation design.

(f) 1. First floor levels that do not meet the separation requirements under par. (e), shall have at least one egress window complying with sub. (6) on that floor level.

2. An egress window to comply with subd. 1. shall be separated from at least one door on the first floor by one of the distances under par. (e).

3. If first floor levels that do not meet the separation requirements under par. (e) contain one or more sleeping rooms, each sleeping room shall have at least one egress window complying with sub. (6).

(g) 1. The exit separation distance required under par. (e) shall be calculated or measured as a straight line from the midpoint of one doorway to the midpoint of the other doorway.

2. For exiting through an attached garage, the separation distance shall be measured using the door connecting the garage and the dwelling. Distance within the garage shall be ignored.

(h) 1. Dwellings consisting of no more than a first floor with a maximum floor area of 400 square feet and a loft area not exceeding half of the first floor area, shall be provided with at least one exit door leading directly to the exterior and at least one egress window that complies with sub. (6).

2. a. Dwellings that meet the size restrictions under subd. 1., are not required to meet the exit separation requirements under par. (e) or (f).

b. If a dwelling that meets the size restrictions under subd. 1., has more than one room on the first floor, the door and the egress window shall be located in different rooms.

(2) **EXITS FROM THE SECOND FLOOR.** (a) At least 2 exits shall be provided from the second floor. One of the exits shall be a stairway or ramp and lead to the first floor or discharge to grade. The second exit may be via a stairway or ramp which discharges to grade or may discharge to a balcony which complies with sub. (10).

(b) Except as provided in par. (c), windows which comply with sub. (6) may be provided in each second floor bedroom in lieu of the second exit from the floor.

(c) Where the second floor is the lowest floor level in a dwelling unit, as in an up-and-down duplex, windows may not be provided as the second exit from the floor.

(3) **EXITS ABOVE THE SECOND FLOOR.** At least 2 exits shall be provided for each habitable floor above the second floor. The exits shall be located such that in case any exit is blocked some other exit will still be accessible to the second floor. The exits shall be stairways or ramps that lead to the second floor or discharge to grade.

(4) **EXITS FROM LOFTS.** (a) At least one stairway exit shall be provided, to the floor below, for a loft exceeding 400 square feet in area.

(b) At least one stairway or ladder exit shall be provided to the floor below for a loft, 400 square feet or less, in area.

(5) **EXITS FROM BASEMENTS AND GROUND FLOORS.** (a) *General.* Except as provided in par. (b), all basements and ground floors shall be provided with at least one exit of the following types:

1. A door to the exterior of the dwelling.
2. A stairway or ramp that leads to the floor above.

(b) *Basements and ground floors used for sleeping.* 1. Basements and ground floors used for sleeping shall be provided with at least 2 exits.

2. The exits shall be located as far apart as practical.
3. The exits may not be accessed from the same ramp or stairway.

4. In addition to the exit type required under par. (a), the second exit from a basement or ground floor used for sleeping shall be one of the following types:

- a. A door to the exterior of the dwelling.
- b. A stairway or ramp that leads to the floor above.
- c. A stairway that leads to a garage provided the garage has an exit door other than the overhead door.
- d. An egress window that complies with sub. (6), located in each bedroom.

(6) **WINDOWS USED FOR EXITING.** Windows which are installed for exit purposes shall comply with the requirements of this subsection.

(a) The window shall be openable from the inside without the use of tools or the removal of a sash. If equipped with a storm or screen, it shall be openable from the inside.

(b) 1. The nominal size of the net clear window opening shall be at least 20 inches by 24 inches irrespective of height or width. Nominal dimensions shall be determined by rounding up fractions of inches if they are  $\frac{1}{2}$ -inch or greater or rounding down fractions of inches if they are less than  $\frac{1}{2}$ -inch.

2. No portion of the window, including stops, stools, meeting rails and operator arms, shall infringe on the required opening.

(c) The area and dimension requirements of par. (b) may be infringed on by a storm window.

(d) 1. For any window used for exiting, the lowest point of clear opening shall be no more than 60 inches above the floor.

2. If the lowest point of clear opening is more than 46 inches above the floor, a permanent platform or fixture shall be installed such that a flat surface at least 20 inches wide and 9 inches deep is located no more than 46 inches directly below the clear opening.

3. The topmost surface of the platform or fixture shall be no more than 24 inches above the floor.

4. The topmost surface of the platform or fixture shall support a live load of at least 200 pounds.

5. A Step used for the sole purpose of reaching the top of the platform or fixture is exempt from the requirements of s. Comm 21.04.

(e) 1. An egress window with any point of clear opening below adjacent grade shall be provided with an areaway in accordance with this section.

2. The width of the areaway shall be at least equal to the width of the window.

3. The areaway shall be a minimum of 36 inches measured perpendicular from the outer surface of the below-grade wall.

4. If the bottom of the areaway is more than 46 inches below adjacent grade or the top of the areaway enclosure, the areaway shall be provided with a ladder or at least one additional step to aid egress. Steps used to comply with this section are exempt from the requirements of s. Comm 21.04.

5. Ladders or other steps used to comply with subd. 4. may infringe on the required area of the areaway by a maximum of 6 inches.

6. The areaway shall be constructed such that water entering the areaway does not enter the dwelling.

**(7) DOORS USED FOR EXITING.** Doors used for exiting shall comply with the following requirements:

(a) One of the exit doors from a dwelling unit shall be a swing-type door at least 36 inches wide by 80 inches high.

(b) 1. Except as allowed under subd. 2., all other required exit doors shall be at least 32 inches wide by 76 inches high.

2. Sliding patio doors used as a required exit shall have a clear opening of at least 30 inches.

(c) Where double doors are used as a required exit, each door leaf shall be at least 30 inches wide and the doors may not have an intermediate mullion.

(d) All exit doors shall be openable from the interior without the use of a key.

**(8) INTERIOR CIRCULATION.** All doors or openings to the following areas shall be at least 80 inches high and either provide a minimum net clear opening width of 30 inches or be a 32-inch door:

(a) At least 50% of the bedrooms.

(b) All common use areas including kitchens, dining rooms, living rooms, family rooms, basements and garages.

(c) At least one full bathroom, including doors or openings to the sink, toilet and tub or shower.

**(9) HALLWAYS.** Hallways shall be at least 3 feet in width except that door hardware, finish trim and heating registers may infringe upon this dimension.

**(10) BALCONIES.** (a) Balconies shall be made of concrete, metal or wood which is treated, protected or naturally decay-resistant in accordance with s. Comm 21.10.

(b) Balconies shall be provided with guardrails in accordance with s. Comm 21.04 (3).

(c) Balconies which are required for exit purposes shall also comply with all of the following requirements:

1. The balcony guardrail shall terminate no more than 46 inches above the floor level of the balcony.

2. The floor level of the balcony shall be no more than 15 feet above the grade below.

3. The floor of the balcony shall have minimum dimensions of 3 feet by 3 feet. The guardrail and its supports may infringe on the dimensions of the required area.

**(11) SPLIT LEVEL DWELLINGS.** In determining the exit requirement in a split level dwelling, all levels that are to be considered a single story shall be within 5 feet of each other.

**(12) TWO-FAMILY DWELLINGS.** In a 2-family dwelling, each dwelling unit shall be provided with exits in compliance with this section.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85; emerg. am. (1) (b), (2) and (5) (b) 2., eff. 5-7-85; r. (1) (b), renum. (1) (a) to be (1), am. (2), (7) and (8), r. and recr. (5) to (6), cr. (6m) and (10) to (12), Register, January, 1989, No. 397, eff. 2-1-89; am. (3) and (7), r. and recr. (10) and (11), Register, March, 1992, No. 435, eff. 4-1-92; am. (8), r. and recr. (10) (a), Register, November, 1995, No. 479, eff. 12-1-95; am. (6m) (b) 1. and 2., r. (6m) (b) 3., Register, January, 1999, No. 517, eff. 2-1-99; r. and recr. (1), (5), (7) and (8), am. (2) (b), r. (6), renum. (6m) to be (6) and r. and recr. (6) (d) and (e) as renum., Register, March, 2001, No. 543, eff. 4-1-01; reprinted to correct printing error in (6) (e) 2., Register September 2001 No. 549; CR 02-077: am. (1) (a), (5) (a) (intro.) and (10) (b), r. and recr. (1) (e), cr. (1) (f) to (h), Register May 2003 No. 569, eff. 8-1-03; CR 03-097: am. (1) (h) 1., Register November 2004 No. 587, eff. 1-1-05.

### Comm 21.04 Stairways and elevated areas.

**(1) SCOPE.** Every interior and exterior stairway, including tub access steps but excluding nonrequired basement stairways which lead directly to the building exterior and stairways leading to attics or crawl spaces, shall conform to the requirements of this section.

**(2) DETAILS.** (a) *Width.* 1. Except for spiral staircases under subd. 2., stairways shall measure at least 36 inches in width. Handrails and associated trim may project a maximum of 4.5 inches into the required width at each side of the stairway.

2. Spiral staircases shall be at least 26 inches wide measured from the outer edge of the supporting column to the inner edge of the handrail.

(b) *Riser height.* 1. a. Except for spiral staircases under subd. 2., risers may not exceed 8 inches in height measured vertically from tread to tread.

b. At the top and bottom of a flight, measurement shall be taken from the top of the nosing to the finished floor surface unless the finished surface is carpeting, in which case measurement shall be made to the hard surface below the carpeting.

2. Risers in spiral staircases may not exceed 9.5 inches in height measured vertically from tread to tread.

(c) *Tread depth.* 1. 'Rectangular treads.' Rectangular treads shall have minimum tread depth of 9 inches measured horizontally from nosing to nosing.

2. 'Spiral staircase treads.' Spiral staircase treads shall have a minimum tread depth of 7 inches from nosing to nosing measured at a point 12 inches from the narrow end of the tread.

3. 'Winder treads in series.' Two or more winder treads may be placed immediately adjacent to each other anywhere in a stairway provided both of the following conditions are met:

a. The winder treads shall have a minimum tread depth of 7 inches measured at a point 12 inches from the narrow end of the tread.

b. The depth of the immediately adjoining winder treads shall be equal at a point 12 inches from the narrow end.

4. Individual winder treads. a. An individual winder tread may be placed between rectangular treads or at the end of a flight of rectangular treads provided the tread depth, measured at a point 12 inches from the narrow end, is equal to the tread depth of the rectangular steps in the flight.

b. There may be more than one individual winder tread in a stairway or in a flight of stairs.

(d) *Headroom.* 1. Stairways shall be provided with a minimum headroom clearance of 76 inches measured vertically from a line parallel to the nosing of the treads to the ceiling, soffit or any overhead obstruction directly above that line.



2. The headroom clearance shall be maintained over an intermediate landing.

3. The headroom clearance shall be maintained over a landing that is at the top or bottom of a stairway for a minimum distance of 36 inches in the direction of travel of the stairway.

(e) *Uniformity.* 1. Within a stairway flight, tread depths and riser heights may vary by a maximum of  $\frac{3}{16}$  inch.

2. The allowed variation in uniformity under subd. 1. may not be used to exceed the maximum riser height under par. (b) or to decrease the minimum tread depth under par. (c).

(f) *Open risers.* Stairways with open risers shall be constructed to prevent the through-passage of a sphere with a diameter of 4 inches or larger between any 2 adjacent treads.

**(3) HANDRAILS AND GUARDRAILS.** (a) *General.* 1. Stair flights with more than 3 risers shall be provided with at least one handrail for the full length of the stair flight.

2. Handrails or guardrails shall be provided on all open sides of stair flights consisting of more than 3 risers and on all open sides of areas that are elevated more than 24 inches above the floor or exterior grade.

3. a. Except as provided in subd. 3. b., handrails and guardrails shall be constructed to prevent the through-passage of a sphere with a diameter of 4 inches or larger.

b. The triangular area formed by the tread, riser and bottom rail shall have an opening size that prevents the through-passage of a sphere with a diameter of 6 inches or larger.

4. Handrails and guardrails shall be designed and constructed to withstand a 200 pound load applied in any direction.

5. Exterior handrails and guardrails shall be constructed of metal, decay resistant or pressure-treated wood, or shall be protected from the weather.

(b) *Handrails.* 1. 'Height.' Handrails shall be located at least 30 inches, but no more than 38 inches above the nosing of the treads. Measurement shall be taken from the hard structural surface beneath any finish material to the top of the rail. Variations in uniformity are allowed only when a rail contacts a wall or newel post or where a turnout or volute is provided at the bottom step.

2. 'Clearance.' The clearance between a handrail and the wall surface shall be at least  $1\frac{1}{2}$  inches.

3. 'Winders.' a. Except as provided under subd. 3. b., the required handrail on winder steps shall be placed on the side where the treads are wider.

b. Where all winder steps in a flight have a tread depth of at least 9 inches from nosing to nosing measured at a point 12 inches from the narrow end of the nosing, the required handrail may be located on either side of the stairway.

4. 'Projection.' Handrails and associated trim may project into the required width of stairs and landings a maximum of  $4\frac{1}{2}$  inches on each side.

5. 'Size and configuration.' Handrails shall be symmetrical about the vertical centerline to allow for equal wraparound of the thumb and fingers.

a. Handrails with a round or truncated round cross sectional gripping surface shall have a maximum whole diameter of 2 inches.

b. Handrails with a rectangular cross sectional gripping surface shall have a maximum perimeter of  $6\frac{1}{4}$  inches with a maximum cross sectional dimension of  $2\frac{7}{8}$  inches.

c. Handrails with other cross sections shall have a maximum cross sectional dimension of the gripping surface of  $2\frac{7}{8}$  inches with a maximum linear gripping surface measurement of  $6\frac{1}{4}$  inches and a minimum linear gripping surface of 4 inches.

**Note:** See appendix for further information on handrail measurement.

6. 'Continuity.' Handrails shall be continuous for the entire length of the stairs except in any one of the following cases:

a. A handrail may be discontinuous at an intermediate landing.

b. A handrail may have newel posts.

c. A handrail may terminate at an intermediate wall provided the lower end of the upper rail is returned to the wall or provided with a flared end, the horizontal offset between the 2 rails is no more than 12 inches measured from the center of the rails, and both the upper and lower rails can be reached from the same tread without taking a step.

(c) *Guardrails.* 1. 'Application.' All openings between floors, and open sides of landings, platforms, balconies or porches that are more than 24 inches above grade or a floor shall be protected with guardrails.

2. 'Height.' Guardrails shall be located at least 36 inches above the floor. Measurement shall be taken from the hard structural surface beneath any finish material to the top of the rail.

3. 'Opening size.' Guardrails shall be constructed to prevent the through-passage of a sphere with a diameter of 4 inches or larger.

**(4) LANDINGS.** (a) *Intermediate landings.* 1. A level intermediate landing shall be provided in any stairway with a height of 12 feet or more.

2. Intermediate landings that connect 2 or more straight flights of stairs, or 2 flights of stairs at a right angle, shall be at least as wide as the stairway and shall measure at least 36 inches in the direction of travel.

3. Curved or irregular landing shall have a radius of at least 36 inches.

4. Curved or irregular landings shall have a minimum straight line measurement of 26 inches between the nosing of the 2 connecting treads measured at a point 18 inches from the narrow end of the landing measured along the nosing of the 2 treads.

(b) *Landings at the top and base of stairs.* A level landing shall be provided at the top and base of every stairs. The landing shall be at least as wide as the stairs and shall measure at least 3 feet in the direction of travel.

(c) *Doors at landings.* 1. Except as provided in subd. 1. a. to c., level landings shall be provided on each side of any door located at the top or base of a stairs, regardless of the direction of swing. In the following exceptions, stairways to attached garages, carports or porches are considered interior stairs:

a. A landing is not required between the door and the top of interior stairs if the door does not swing over the stairs.

b. A landing is not required between the door and the top of an interior stairs of 1 or 2 risers regardless of the direction of swing.

c. A landing is not required between a sliding glass door and the top of an exterior stairway of 3 or fewer risers.

2. The exterior landing, platform or sidewalk at an exterior doorway shall be located a maximum of 8 inches below the interior floor elevation and shall have a length of at least 36 inches in the direction of travel out of the dwelling.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85; am. (intro.), r. and recr. (1) (c), renum. (3) (f) to Comm 21.042, Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. (intro.) and (3) (c), am. (1) (a), (2) (a) and (c) 2. and (3) (a), cr. (2) (c) 6., March, 1992, No. 435, eff. 4-1-92; r. and recr., Register, November, 1995, No. 479, eff. 12-1-95; am. (1) (c) 1. and (d), renum. (2) (intro.) to (b) to be (2) (a) to (c) and am. (a), r. (2) (b) (intro.), Register, February, 1997, No. 494, eff. 3-1-97; reprinted to restore dropped copy, Register, March, 1997, No. 495; r. (1), renum. (intro.) to be (1) and am., renum. (2) and (3) to be (3) and (4), cr. (2) and r. and recr. (4) (a), Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077: am. (2) (b) 1., (e) 1. and (3) (a), cr. (2) (f) and (3) (c) 3., r. and recr. (3) (b) 3., renum. (4) (c) to be (4) (c) 1. (intro.), a. to c. and 2. and am. (4) (c) 1. (intro.) and 2. Register May 2003, No. 569, eff. 8-1-03; CR 03-097: am. (2) (f), (3) (a) 3., and (c) 3. Register November 2004 No. 587, eff. 1-1-05.

**Comm 21.042 Ladders.** Ladders which are used as part of a required exit shall conform to this section.

**(1) DESIGN LOAD.** Ladders shall be designed to withstand loads of at least 200 pounds.

**(2) TREAD OR RUNGS.** (a) Minimum tread requirements shall be specified in Table 21.042. Treads less than 9 inches in width shall have open risers. All treads shall be uniform in dimension.

TABLE 21.042

Pitch of Ladder Angle to Horizontal (degrees)	Maximum rise (inches)	Minimum Tread (inches)
41.6 to 48.4	8	9
greater than 48.4 to 55.0	9	8
greater than 55.0 to 61.4	10	7
greater than 61.4 to 67.4	11	6
greater than 67.4 to 71.6	12	5
greater than 71.6 to 75.9	12	4
greater than 75.9 to 80.5	12	3
greater than 80.5 to 90	12	2

(b) Rungs may only be used for ladders with a pitch range of 75° to 90°. Rungs shall be at least 1 inch in diameter for metal ladders and 1½ inch for wood ladders. All rungs shall be uniform in dimension.

(3) RISERS. Risers shall be uniform in height and shall conform with Table 21.042.

(4) WIDTH. The width of the ladder shall be a minimum of 20 inches wide and a maximum of 30 inches wide.

(5) HANDRAILS. (a) Handrails shall be required for ladders with pitches less than 65°.

(b) Handrails shall be located so the top of the handrail is at least 30 inches, but not more than 38 inches, above the nosing of the treads.

(c) Open handrails shall be provided with intermediate rails or an ornamental pattern such that a sphere with a diameter of 6 inches or larger cannot pass through.

(d) The clearance between the handrail and the wall surface shall be at least 1½ inches.

(e) Handrails shall be designed and constructed to withstand a 200 pound load applied in any direction.

(6) CLEARANCES. (a) The ladder shall have a minimum clearance of at least 15 inches on either side of the center of the tread.

(b) The edge of the tread nearest to the wall behind the ladder shall be separated from the wall by at least 7 inches.

(c) A passage way clearance of at least 30 inches parallel to the slope of a 90° ladder shall be provided. A passage way clearance of at least 36 inches parallel to the slope of a 75° ladder shall be provided. Clearances for intermediate pitches shall vary between these 2 limits in proportion to the slope.

(d) For ladders with less than a 75° pitch the vertical clearance above any tread or rung to an overhead obstruction shall be at least 6 feet 4 inches measured from the leading edge of the tread or rung.

**History:** Renum. from Comm 21.04 (3) (f), cr. (intro.), Register, January, 1989, No. 397, eff. 2-1-89; am. (6) (b), Register, November, 1995, No. 479, eff. 12-1-95; am. (5) (b) and (c), Register, January, 1999, No. 517, eff. 2-1-99.

**Comm 21.045 Ramps.** Every exterior or interior ramp which leads to or from a required exit shall comply with the requirements of this section.

(1) SLOPE. Ramps shall not have a gradient greater than 1 in 8 or one foot of rise in 8 feet of run. Walkways with gradients less than 1 in 20 or one foot of rise in 20 feet of run are not considered to be ramps.

(2) SURFACE AND WIDTH. Ramps shall have a slip resistant surface and shall have a minimum width of 36 inches measured between handrails.

(3) HANDRAILS. Handrails shall be provided on all open sides of ramps. Every ramp that overcomes a change in elevation of more than 8 inches shall be provided with at least one handrail.

(a) Ramps which have a gradient greater than 8.33% or 1:12 or one foot rise in 12 feet of run and which overcome a change in elevation of more than 24 inches, shall be provided with handrails on both sides.

(b) Handrails shall be located so the top of the handrail is at least 30 inches, but not more than 38 inches above the ramp surface.

(c) Open-sided ramps shall have the area below the handrail protected by intermediate rails or an ornamental pattern to prevent the passage of a sphere with a diameter of 4 inches or larger.

(d) The clear space between the handrail and any adjoining wall shall be at least 1½ inches.

(4) LANDINGS. A level landing shall be provided at the top, at the foot and at any change in direction of the ramp. The landing shall be at least as wide as the ramp and shall measure at least 3 feet in the direction of travel.

**History:** Cr. Register, January, 1989, No. 397, eff. 2-1-89; am. (3) (intro.), Register, March, 1992, No. 435, eff. 4-1-92; am. (3) (c), Register, November, 1995, No. 479, eff. 12-1-95; am. (3) (b), Register, January, 1999, No. 517, eff. 2-1-99; CR 03-097: am. (3) (c) Register November 2004 No. 587, eff. 1-1-05.

**Comm 21.05 Light and ventilation.** (1) NATURAL LIGHT. All habitable rooms shall be provided with natural light by means of glazed openings. The area of the glazed openings shall be at least 8% of the net floor area, except under the following circumstances:

(a) *Exception.* Habitable rooms, other than bedrooms, located in basements or ground floors do not require natural light.

(b) *Exception.* Natural light may be obtained from adjoining areas through glazed openings, louvers or other approved methods. Door openings into adjoining areas may not be used to satisfy this requirement.

(2) VENTILATION. (a) *Natural ventilation.* Natural ventilation shall be provided to all habitable rooms by means of openable doors, skylights or windows. The net area of the openable doors, skylights or windows shall be at least 3.5% of the net floor area of the room. Balanced mechanical ventilation may be provided in lieu of openable exterior doors, skylights or windows provided the system is capable of providing at least one air change per hour of fresh outside air while the room is occupied. Infiltration may not be considered as make-up air for balancing purposes.

(b) *Exhaust ventilation.* All exhaust ventilation shall terminate outside the building.

(3) ATTIC VENTILATION. Ventilation above the ceiling or attic insulation shall be provided as specified in s. Comm 22.08 (1).

(4) CRAWL SPACE VENTILATION. (a) *General.* Unheated crawl spaces shall be ventilated in accordance with s. Comm 22.08 (2).

(b) *Vapor retarder.* 1. Crawl spaces shall be provided with a vapor retarder that has a transmission rate of 0.1 perm or less.

2. All decayable organic material, including topsoil, shall be removed from crawl space floors prior to placing the vapor retarder.

(5) SAFETY GLASS. Except as provided in par. (e), glazing shall consist of safety glass meeting the requirements of ANSI Z 97.1 when installed in any of the following locations:

(a) In any sidelight adjacent to a door where the nearest point is within 2 feet of the door.

(b) In a wall that comprises part of a tub or shower enclosure where the glazing is within 5 feet vertically of the lowest drain inlet and within 3 feet horizontally of the nearest part of the inner rim of the tub.

(c) Within 4 feet vertically of a tread or landing in a stairway and within one foot horizontally of the near edge of the tread or landing.

(d) Within 4 feet vertically of the floor and 3 feet horizontally of the nosing of the top or bottom tread of a stair.

(e) Safety glass is not required where the size of an individual pane of glass is 8 inches or less in the least dimension.

**Note:** The U.S. Consumer Product Safety Commission requires safety glass for glazing in internal and external doors, including storm doors and patio doors, as well as for the tub or shower enclosures themselves. These federal rules, contained in 16 CFR, subchapter B, part 1201, apply in addition to any state rules or statutes.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. (1) and (2), Register, February, 1985, No. 350, eff. 3-1-85; r. and recr. (3) and (4), Register, July, 1986, No. 367, eff. 1-1-87; am. (4), Register, January, 1989, No. 397, eff. 2-1-89; am. (2) (a), (4) and (5), Register, March, 1992, No. 435, eff. 4-1-92; am. (2) (a), Register, November, 1995, No. 479, eff. 12-1-95; am. (3), r. and recr. (4) and (5), Register, January, 1999, No. 517, eff. 2-1-99; CR 02-077: am. (1) (a) and (5) (b) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.06 Ceiling height.** All habitable rooms, kitchens, hallways, bathrooms and corridors shall have a ceiling height of at least 7 feet. Habitable rooms may have ceiling heights of less than 7 feet provided at least 50% of the room's floor area has a ceiling height of at least 7 feet. Beams and girders or other projections shall not project more than 8 inches below the required ceiling height.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85.

**Comm 21.07 Attic and crawl space access.**

**(1) ATTIC.** Attics with 150 or more square feet of area and 30 or more inches of clear height between the top of the ceiling framing and the bottom of the rafter or top truss chord framing shall be provided with an access opening of at least 14 by 24 inches, accessible from inside the structure.

**(2) CRAWL SPACES.** Crawl spaces with 18 inches of clearance or more between the crawl space floor and the underside of the house floor joist framing shall be provided with an access opening of at least 14 by 24 inches.

**Note:** Access to plumbing or electrical systems may be required under chs. Comm 82-87, Plumbing Code or ch. Comm 16, Electrical Code, Volume 2.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. Register, March, 1992, No. 435, eff. 4-1-92; am. (1), Register, November, 1995, No. 479, eff. 12-1-95.

**Comm 21.08 Fire separation and dwelling unit separation.**

**(1) FIRE SEPARATION.** Dwelling units shall be separated from garage spaces, accessory buildings and other dwelling units in accordance with Table 21.08 and the following requirements:

**TABLE 21.08**

Between Dwelling And:	Distance Between Objects <sup>1</sup>	Fire Rated Construction <sup>2, 5</sup>
Detached garage or accessory building on same property	Less than 5 feet	3/4-hour wall <sup>3</sup> 1/3-hour door or window <sup>3</sup>
Another dwelling on same property	Less than 5 feet	3/4-hour wall <sup>4</sup> 1/3-hour door or window <sup>4</sup>
Detached garage, accessory building, or other dwelling on same property	5 to 10 feet	3/4-hour wall <sup>3</sup> No requirement on openings
Detached garage, accessory building, or other dwelling on same property	More than 10 feet	No requirements
Property Lines	Less than 3 feet	3/4-hour wall 1/3-hour door or window
Property Lines	3 feet or more	No Requirements

<sup>1</sup>Distance shall be measured perpendicular from wall to wall or property line, ignoring overhangs.

<sup>2</sup>Fire rated construction shall protect the dwelling from an exterior fire source.

<sup>3</sup>Fire rated construction may be in either facing wall.

<sup>4</sup>Fire rated construction shall be in both facing walls.

<sup>5</sup>The methods for garage separation in par. (a) 1. are examples of 3/4 hour wall construction.

**(a) Attached garages.** 1. The walls and ceiling between an attached garage and any portion of the dwelling, including attic or soffit areas, shall be 3/4-hour fire-resistive construction or shall be constructed as specified in any of the following:

a. One layer of 5/8-inch Type X gypsum drywall shall be used on the garage side of the separation wall or ceiling.

b. One layer of 1/2-inch gypsum drywall shall be used on each side of the separation wall or ceiling.

c. Two layers of 1/2-inch gypsum drywall shall be used on the garage side of the separation wall or ceiling.

2. For all methods listed under subd. 1., drywall joints shall comply with one of the following:

a. Joints shall be taped or sealed.

b. Joints shall be fitted so that the gap is no more than 1/20-inch with joints backed by either solid wood or another layer of drywall such that the joints are staggered.

**Note:** 1/20-inch is approximately the thickness of a U.S. dime.

3. Vertical separations between an attached garage and a dwelling shall extend from the top of a concrete or masonry foundation to the underside of the roof sheathing or fire-resistive ceiling construction.

4. Adjoining garage units are not required to be separated from each other.

**(b) Structural elements exposed in an attached garage.** Beams, columns and bearing walls which are exposed to the garage and which provide support for habitable portions of the dwelling shall be protected by one of the methods specified in par.

(a) 1. a. or c. or other 3/4 hour fire-resistive protection.

**(c) Doors.** The door and frame assembly between the dwelling unit and an attached garage shall be labeled by an independent testing agency as having a minimum fire-resistive rating of 20 minutes. The test to determine the 20-minute rating is not required to include the hose stream portion of the test.

**Note:** Acceptable tests for fire rating of door assemblies include ASTM E-152, UL 10B, and NFPA 252.

**(d) Other openings.** 1. Access openings in fire separation walls or ceilings shall maintain the required separation and shall have any drywall edges protected from physical damage.

2. The cover or door of the access opening shall be permanently installed with hardware that will maintain it in the closed position when not in use.

**(2) DWELLING UNIT SEPARATION.** **(a) General.** In 2-family dwellings, dwelling units shall be separated from each other, from common use areas, from shared attics, and from exit access corridors.

**(b) Doors.** Any door installed in the dwelling unit separation shall have the door and frame assembly labeled by an independent testing agency as having a minimum fire-resistive rating of 20 minutes. The test to determine the 20-minute rating is not required to include the hose stream portion of the test.

**(c) Walls.** Walls in the dwelling unit separation shall be protected by not less than one layer of 1/2-inch gypsum wallboard or equivalent on each side of the wall with joints in compliance with sub. (1) (a) 2.

**(d) Floors and ceilings.** A fire protective membrane of one layer of 5/8-inch Type X gypsum wallboard with joints in compliance with sub. (1) (a) 2., shall be provided on the ceiling beneath the floor construction that provides the separation.

**(e) Attics and concealed roof spaces.** 1. Attic areas, mansards, overhangs and other concealed roof spaces shall be totally separated above and in line with the tenant separation wall.

2. Acceptable attic separation materials include:

a. 2-inch nominal lumber.

b. Two layers of one-inch nominal lumber.

c. 1/2-inch nominal plywood or wood structural panel.

d. 1/2-inch gypsum board.

e. Fiberglass or mineral wool batt insulation may be used in an unsupported condition provided the least dimension of the opening does not exceed 4 inches.

**(3) PENETRATIONS.** **(a) Ducts.** 1. Except as allowed under subd. 2., all heating and ventilating ducts that penetrate a required separation shall be protected with a listed fire damper with a rating of at least 90 minutes.

2. The fire damper required under subd. 1. may be omitted in any of the following cases:

a. There is a minimum of 6 feet of continuous steel ductwork on at least one side of the penetration.

b. The duct has a maximum cross-sectional area of 20 square inches.

**(b) Electrical and plumbing components.** Penetrations of a required separation by electrical and plumbing components shall be firmly packed with noncombustible material or shall be protected with a listed through-penetration firestop system with a rating of at least one hour.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85; cr. (1m), am. (2), (5) (c) and Table, Register, January, 1989, No. 397, eff. 2-1-89; am. (2), (4) and (5) (a) (intro.), renum. (5) (b)



and (c) to be (5) (c) and (d) and am. (5) (d), cr. (5) (b) and (e), (6), Register, March, 1992, No. 435, eff. 4-1-92; r. (3) (a), (5) (d), renum. (3) (b) and (c), (5) (e) to be (3) (a) and (b), (5) (d), am. (5) (a) (intro.), (6), cr. (6) (c) to (e), Register, November, 1995, No. 479, eff. 12-1-95; r. and recr. (5) and (6) (b), am. (6) (c) and (d), r. (6) (e) and cr. (7), Register, January, 1999, No. 517, eff. 2-1-99; r. (1) to (4), renum. (5) to (7) to be (1) to (3), and cr. (2) (e), Register, March, 2001, No. 543, eff. 4-1-01; corrections in (2) (c) and (d) were made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 02-077: am. (1) (a) 1. and (2) (a) to (c) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.085 Fireblocking. (1) FIREBLOCKING LOCATIONS.** Fireblocking shall be provided in all of the following locations:

(a) In concealed spaces of walls and partitions, including furred spaces, at the ceiling and floor levels.

(b) At all interconnections between concealed vertical and horizontal spaces including the attachment between a carport and a dwelling.

(c) In concealed spaces between stair stringers at the top and bottom of the run and at any intervening floor level.

(d) At all openings around wires, cables, vents, pipes, ducts, chimneys and fireplaces at ceiling and floor level.

**(2) FIREBLOCKING MATERIALS.** Fireblocking shall consist of one of the following:

(a) 2-inch nominal lumber.

(b) Two layers of one-inch nominal lumber.

(c) One thickness of  $3/4$ -inch nominal plywood or wood structural panel with any joints backed with the same material.

(d) One thickness of  $1/2$ -inch gypsum wallboard, face nailed or face screwed to solid wood, with any joints backed with the same material.

(e) Fiberglass or mineral wool batt insulation may be used if both of the following conditions are met:

1. The least dimension of the opening may not exceed 4 inches.

2. The batt shall be installed to fill the entire thickness of the opening or stud cavity.

(f) For wires, cables, pipes and vents only, non-shrinking caulk, putty mortar, or similar material may be used provided no dimension of the opening exceeds  $1/2$  inch around the penetrating object.

(g) For chimneys, fireplaces and metal vents, fireblocking shall be metal, cement board or other noncombustible material.

**History:** Cr. Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077: am. (1) (b) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.09 Smoke detectors. (1)** A listed and labeled multiple-station smoke alarm with battery backup shall be installed in all of the following locations:

(a) An alarm shall be installed inside each sleeping room.

(b) On floor levels that contain one or more sleeping areas, an alarm shall be installed outside of the sleeping rooms, in the vicinity of each sleeping area.

(c) On floor levels that do not contain a sleeping area, an alarm shall be installed in a common area on each floor level.

**Note:** Section 50.035 (2), Stats., requires the installation of a complete low voltage, interconnected or radio-transmitting smoke detection system in all community-based residential facilities including those having 8 or fewer beds.

**Note:** Section 101.645 (3), Stats., requires the owner of a dwelling to install a functional smoke detector in the basement of the dwelling and on each floor level except the attic or storage area of each dwelling unit. The occupant of such a dwelling unit shall maintain any smoke detector in that unit, except that if any occupant who is not the owner, or any state, county, city, village or town officer, agent or employee charged under statute or municipal ordinance with powers or duties involving inspection of real or personal property, gives written notice to the owner that the smoke detector is not functional the owner shall provide, within 5 days after receipt of that notice, any maintenance necessary to make that smoke detector functional.

**Note:** Section 101.745 (4), Stats., requires the manufacturer of a manufactured building to install a functional smoke detector in the basement of the dwelling and on each floor level except the attic or storage area of each dwelling unit.

**(2)** Smoke detectors required by this section shall be continuously powered by the house electrical service, and shall be interconnected so that activation of one detector will cause activation of all detectors.

**(3)** For family living units with one or more communicating split levels or open adjacent levels with less than one full story separation between levels, one smoke detector on the upper level shall suffice for an adjacent lower level, including basements. Where there is an intervening door between one level and the adjacent lower level, smoke detectors shall be installed on each level.

**(4)** Smoke alarms and detectors shall be maintained in accordance with the manufacturer's specifications.

**(5)** For envelope dwellings, at least 3 smoke alarms shall be placed in the air passageways. The alarms shall be placed as far apart as possible.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85; r. and recr. Register, April, 1990, No. 412, eff. 5-1-90; renum. to be (1), cr. (2) and (3), Register, March, 1992, No. 435, eff. 4-1-92; renum. (2) and (3) to be (3) and (4), cr. (2), Register, November, 1995, No. 479, eff. 12-1-95; r. and recr. (1), r. (2), renum. (3) and (4) to be (2) and (3), and cr. (4) and (5), Register, March, 2001, No. 543, eff. 4-1-01.

**Comm 21.10 Protection against decay and termites. (1)** Wood used in any of the locations specified under this section shall meet both of the following requirements:

(a) The wood shall be pressure treated with preservative or shall be a naturally durable and decay-resistant species or shall be engineered to be decay resistant.

(b) The wood shall be pressure treated with preservative or shall be naturally termite-resistant unless additional steps are taken to make the wood termite-resistant.

**(2)** Wood used in the following locations shall be as required under sub. (1):

(a) Embedded in earth.

(b) Floor joists that span directly over and within 18 inches of earth.

(c) Girders that span directly over and within 12 inches of earth.

(d) Sills and rim joists that rest on concrete or masonry and are within 8 inches above exterior grade.

(e) Siding within 6 inches of earth.

(f) Ends of wood structural members built into masonry or concrete walls and having clearances of less than  $1/2$  inch on the top, sides and ends.

(g) Bottom plates of load bearing walls on slab floors in basements or garages.

(h) Bottom plates of garage walls that rest on concrete or masonry and are within 8 inches of exterior grade.

(i) Columns in direct contact with concrete or masonry unless supported by a structural pedestal or plinth block at least 3 inches above the floor.

(j) Any structural part of an outdoor deck, including the decking.

**(3)** Wood girders that rest directly on exterior concrete or masonry shall be protected by one of the following methods:

(a) The wood shall be pressure treated with preservative or shall be a naturally durable and decay-resistant species.

(b) Material, such as pressure-treated plywood, flashing material, steel shims, or water-resistant membrane material shall be placed between the wood and the concrete or masonry.

**(4)** (a) All pressure-treated wood and plywood shall be identified by a quality mark or certificate of inspection of an approved inspection agency which maintains continued supervision, testing and inspection over the quality of the product.

(b) Pressure-treated wood used below grade in foundations shall be labeled to show conformance with AWPA C-22 "Lumber and Plywood for Permanent Wood Foundations - Preservative Treatment by Pressure Processes" and labeled by an inspection agency accredited by the American Lumber Standards Committee.

**Note:** Heartwood of redwood, cypress, black walnut, catalpa, chestnut, sage orange, red mulberry, white oak, or cedar lumber are considered by the department to be naturally decay-resistant. Heartwood of bald cypress, redwood, and eastern red cedar are considered by the department to be naturally termite resistant.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85; am. (1) (b) and (3), Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. (1) (intro.) and (b), am. (1) (f), renum. (3) (intro.)



to be (3) (a), cr. (3) (b), Register, March, 1992, No. 435, eff. 4-1-92; am. (1) (a), (b), (3), cr. (1) (g), Register, November, 1995, No. 479, eff. 12-1-95; r. (1) and (2), renum. (3) to be (4), and cr. (1) to (3), Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077; am. (4) (a) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.11 Foam plastic. (1) (a) General.** Foam plastic insulation shall have a flame-spread rating of 75 or less and a smoke-developed rating of 450 or less when tested in accordance with ASTM E-84.

(b) *Thermal barrier.* Except as provided in par. (c), foam plastic insulation shall be separated from the interior of the dwelling by one of the following thermal barriers:

1. 1/2-inch gypsum wallboard.
2. 1/2-inch nominal wood structural panel.
3. 3/4-inch sawn lumber with tongue-and-groove or lap joints.
4. 1-inch of masonry or concrete.
5. A product or material shown by an independent laboratory to limit the temperature rise on the unexposed surface to 250° F for 15 minutes when tested in accordance with ASTM E-119.

6. For doors only, sheet metal with a minimum thickness of 26 standard steel gauge or aluminum with a minimum thickness of 0.032 inch.

**Note:** Number 26 standard steel gauge is approximately equal to 0.018-inch.

(c) *Exemptions from thermal barrier requirement.* The following applications of foam plastic do not require a thermal barrier:

1. On overhead garage doors.
2. In the box sill of the basement or ground floor, above the bottom of the floor joists.

(2) Insulation that does not meet the requirements of this section may be approved by the department in accordance with s. Comm 20.18. Approval will be based on tests that evaluate materials or products representative of actual end-use applications.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. (1) (b), Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. (1) (intro.), am. (1) (a), renum. (1) (b) and (c) to be (1) (c) and (d) and am. (1) (c), cr. (1) (b), Register, March, 1992, No. 435, eff. 4-1-92; am. (1) (d), (2), Register, November, 1995, No. 479, eff. 12-1-95; r. and recr. Register, March, 2001, No. 543, eff. 4-1-01.

### Subchapter III — Excavations

**Comm 21.12 Grade.** The finished grade of the soil shall slope away from the dwelling at a rate of at least 1/2-inch per foot for a minimum distance of 10 feet, or to the lot line, whichever is less.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; CR 02-077; am. Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.125 Erosion control and sediment control. (1) GENERAL.** (a) Where land disturbing construction activity is to occur erosion and sediment control practices shall be employed, as necessary, and maintained to prevent or reduce the potential deposition of soil or sediment to all of the following:

1. The waters of the state.
2. Adjacent properties.

(b) Land disturbing construction activities, except those activities necessary to implement erosion or sediment control practices, may not begin until the sediment control practices are in place for each area to be disturbed in accordance with the approved plan.

(c) Erosion and sediment control practices shall be maintained until the disturbed areas are stabilized. A disturbed area shall be considered stabilized by vegetation when a perennial cover has been established with a density of at least 70%.

(d) Erosion and sediment control practices shall either be approved by the department or listed by the department of natural resources in accordance with the process under s. NR 151.32 (2).

**Note:** Listed practices can be found through the Safety and Buildings Division website at [www.commerce.state.wi.us/SB](http://www.commerce.state.wi.us/SB) or by contacting the Safety and Buildings Division at (608) 266-3151.

(2) **MANDATED PRACTICES.** Specific practices at each site where land disturbing construction activity is to occur shall be utilized to prevent or reduce all of the following:

(a) The deposition of soil from being tracked onto streets by vehicles.

(b) The discharge of sediment from disturbed areas into on-site storm water inlets.

(c) The discharge of sediment from disturbed areas into abutting waters of the state.

(d) The discharge of sediment from drainage ways that flow off the site.

(e) The discharge of sediment by dewatering activities.

(f) The discharge of sediment eroding from soil stockpiles existing for more than 7 days.

(3) **CONTROL STANDARDS.** Including the practices under sub. (2), additional erosion and sediment control practices shall be employed, as necessary, to accomplish one of the following:

(a) A potential annual cumulative soil loss rate of not more than one of the following:

1. Five tons per acre per year where sand, loamy sand, sandy loam, loam, sandy clay loam, clay loam, sandy clay, silty clay or clay textures are exposed.

2. Seven and a half tons per acre per [year] where silt, silty clay loam or silt loam textures are exposed.

(b) A reduction of at least 80% of the potential sediment load in storm water runoff from the site on an average annual basis as compared with no sediment or erosion controls for the site when the land disturbing construction activity involves one or more acres.

(c) A reduction of at least 40% of the potential sediment load in storm water runoff from the site on an average annual basis as compared with no sediment or erosion controls for the site where less than one acre of land disturbing construction activity is to occur.

**Note:** See appendix for further explanatory material regarding compliance solutions for 80 and 40% reductions.

(4) **SOIL LOSS ANALYSIS.** Potential soil loss shall be determined using an engineer analytical modeling acceptable to the department.

**Note:** Note: The Revised Universal Soil Loss Equation II is an example of an acceptable model to determine soil loss.

(5) **MONITORING.** (a) The owner or owner's agent shall check the erosion and sediment control practices for maintenance needs at all the following intervals until the site is stabilized:

1. At least weekly.
2. Within 24 hours after a rainfall event of 0.5 inches or greater. A rainfall event shall be considered to be the total amount of rainfall recorded in any continuous 24 hour period.
3. At all intervals cited on the erosion and sediment control plan.

(b) The owner or owner's agent shall maintain a monitoring record when the land disturbing construction activity involves one or more acres.

(c) The monitoring record shall contain at least the following information:

1. The condition of the erosion and sediment control practices at the intervals specified under par. (a).
2. A description of the maintenance conducted to repair or replace erosion and sediment control practices.

(6) **MAINTENANCE.** (a) 1. Except as provided in subd. 3., off-site sediment deposition resulting from the failure of an erosion or sediment control practice shall be cleaned up by the end of the next day.

**Note:** Contact the Department of Natural Resources before attempting to clean up any sediment deposited or discharged into the waters of the state.

2. Except as provided in subd. 3., off-site soil deposition, resulting from construction activity, that creates a nuisance shall be cleaned up by the end of the work day.

3. A municipality may enact more stringent requirements regarding cleanup of soil or sediment deposition onto public ways.

(b) 1. Except as required in subd. 2., the owner or owner's agent shall complete repair or replacement of erosion and sedi-

ment control practices as necessary within 48 hours of an interval specified under sub. (5).

2. When the failure of erosion or sediment control practices results in an immediate threat of sediment entering public sewers or the waters of the state, procedures shall be implemented immediately to repair or replace the practices.

**History:** Cr. Register, September, 1992, No. 441, eff. 12-1-92; am. (1) (b), Register, November, 1995, No. 479, eff. 12-1-95; am. (1) (a), renum. (1) (b) to (e) to be (1) (c) to (f) and am. (c), cr. (1) (b), Register, February, 1997, No. 494, eff. 3-1-97; CR 02-077; cr. (4) Register May 2003 No. 569, eff. 8-1-03; CR 05-113; r. and recr. Register December 2006 No. 612, eff. 4-1-07.

**Comm 21.126 Storm water management.** Storm water management practices shall be employed in accordance with s. NR 151.12 and maintained when the land disturbing construction activity involves one or more acres.

**Note:** See appendix for further explanatory material.

**History:** CR 05-113; cr. Register December 2006 No. 612, eff. 4-1-07.

**Comm 21.13 Excavations adjacent to adjoining property.** (1) NOTICE. Any person making or causing an excavation which may affect the lateral soil support of adjoining property or buildings shall provide at least 30 days written notice to all owners of adjoining buildings of the intention to excavate. The notice shall state that adjoining buildings may require permanent protection.

(a) *Exception.* The 30-day time limit for written notification may be waived if such waiver is signed by the owner(s) of the adjoining properties.

(2) RESPONSIBILITY FOR UNDERPINNING AND FOUNDATION EXTENSIONS. (a) *Excavations less than 12 feet in depth.* If the excavation is made to a depth of 12 feet or less below grade, the person making or causing the excavation shall not be responsible for any necessary underpinning or extension of the foundations of any adjoining buildings.

(b) *Excavations greater than 12 feet in depth.* If the excavation is made to a depth in excess of 12 feet below grade, the owner(s) of adjoining buildings shall be responsible for any necessary underpinning or extension of the foundations of their buildings to a depth of 12 feet below grade. The person making or causing the excavation shall be responsible for any underpinning or extension of foundations below the depth of 12 feet below grade.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80.

**Comm 21.14 Excavations for footings and foundations.** (1) EXCAVATIONS BELOW FOOTINGS AND FOUNDATIONS. No excavation shall be made below the footing and foundation unless provisions are taken to prevent the collapse of the footing or foundation.

(2) EXCAVATIONS FOR FOOTINGS. All footings shall be located on undisturbed or compacted soil, free of organic material, unless the footings are reinforced to bridge poor soil conditions.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80.

**Subchapter IV — Footings**

**Comm 21.15 Footings.** The dwelling shall be supported on a structural system designed to transmit and safely distribute the loads to the soil. The loads for determining the footing size shall include the weight of the live load, roof, walls, floors, pier or column, plus the weight of the structural system and the soil over the footing. Footings shall be sized to not exceed the allowable material stresses. The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing values of the soil.

(1) SIZE AND TYPE. Unless designed by structural analysis, unreinforced concrete footings shall comply with the following requirements:

(a) *Continuous footings.* The minimum width of the footing on each side of the foundation wall shall measure at least 4 inches wider than the wall. The footing depth shall be at least 8 inches nominal. Footing placed in unstable soil shall be formed. Lintels may be used in place of continuous footings when there is a change in footing elevation.

**Note:** Unstable soil includes soils which are unable to support themselves.

(b) *Column or pier footing.* The minimum width and length of column or pier footings shall measure at least 2 feet by 2 feet. The depth shall measure at least 12 inches nominal. The column shall be so placed as to provide equal projections on each side of the column.

(c) *Trench footings.* Footings poured integrally with the wall may be used when soil conditions permit. The minimum width shall be at least 8 inches nominal.

(d) *Chimney and fireplace footings.* Footing for chimneys or fireplaces shall extend at least 4 inches on each side of the chimney or fireplace. The minimum depth shall measure at least 12 inches nominal.

(e) *Floating slabs.* Any dwelling supported on a floating slab on grade shall be designed through structural analysis. Structures supported on floating slabs may not be physically attached to structures that are supported by footings that extend below the frost line unless an isolation joint is used between the structures.

(f) *Deck footings.* Decks attached to dwellings and detached decks which serve an exit shall be supported on a structural system designed to transmit and safely distribute the loads to the soil. Footings shall be sized to not exceed the allowable material stresses. The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing values of the soil.

(2) SOIL-BEARING CAPACITY. No footing or foundation shall be placed on soil with a bearing capacity of less than 2,000 pounds per square foot unless the footing or foundation has been designed through structural analysis. The soil-bearing values of common soils may be determined through soil identification.

**Note:** The department will accept the soil-bearing values for the types of soil listed in the following table:

Type of soil	PSF
1. Wet, soft clay; very loose silt; silty clay	2,000
2. Loose, fine sand; medium clay; loose sandy clay soils	2,000
3. Stiff clay; firm inorganic silt	3,000
4. Medium (firm) sand; loose sandy gravel; firm sandy clay soils; hard dry clay	4,000
5. Dense sand and gravel; very compact mixture of clay, sand and gravel	6,000
6. Rock	12,000

(a) *Minimum soil-bearing values.* If the soil located directly under a footing or foundation overlies a layer of soil having a smaller allowable bearing value, the smaller soil-bearing value shall be used.

(b) *Unprepared fill material, organic material.* No footing or foundation shall be placed upon unprepared fill material, organic soil, alluvial soil or mud unless the load will be supported. When requested, soil data shall be provided.

**Note:** The decomposition of organic material in landfill sites established for the disposal of organic wastes may produce odorous, toxic and explosive concentrations of gas which may seep into buildings through storm sewers and similar underground utilities unless provisions are taken to release the gases to the atmosphere.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. (1) (a), Register, January, 1989, No. 397, eff. 2-1-89; cr. (1) (f), Register, March, 1992, No. 435, eff. 4-1-92; am. (1) (e), Register, November, 1995, No. 479, eff. 12-1-95; am. (1) (e), Register, March, 2001, No. 543, eff. 4-1-01.

**Comm 21.16 Frost penetration.** (1) GENERAL. Footings and foundations, including those for ramps and stoops, shall be placed below the frost penetration level, but in no case less than 48 inches below grade measured adjacent to the footing or foundation. Footings shall not be placed over frozen material.

(2) EXCEPTIONS. (a) Floating slabs constructed on grade need not be installed below the minimum frost penetration line provided measures have been taken to prevent frost forces from damaging the structure.

(b) Grade beams need not be installed to the minimum frost penetration line provided measures are taken to prevent frost forces from damaging the structure.

(c) Stoops or ramps need not be installed below the minimum frost penetration level provided measures are taken to prevent frost forces from damaging the structure.

(d) Footings or foundations may bear directly on rock located less than 48 inches below grade. Prior to placement, the rock shall be cleaned of all earth. All clay in the crevices of the rock shall be removed to the level of frost penetration or 1-1/2 times the width of the rock crevice. Provisions shall be taken at grade to prevent rain water from collecting along the foundation wall of the building.

(e) Portions of footings or foundations which are located directly below window areaways which are required to be installed in accordance with s. Comm 21.03 (6), are exempt from the requirements of sub. (1).

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. (intro.), Register, February, 1985, No. 350, eff. 3-1-85; renum. (intro.) and (1) to be (1) and (2) and am. (2) (d), cr. (2) (e), Register, January, 1989, No. 397, eff. 2-1-89; am. (1), Register, November, 1995, No. 479, eff. 12-1-95; correction in (2) (e) made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543.

### Comm 21.17 Drain tiles. (1) DETERMINATION OF NEED.

(a) *New construction.* 1. Except as provided under sub. (2), a complete drain tile or pipe system shall be installed around the foundation of dwellings under construction where groundwater occurs above the bottom of the footing.

2. For the purposes of this section, a complete drain tile or pipe system includes the drain tile or pipe installed inside and outside the foundation at the footing level, bleeders connecting the inside tile or pipe to the outside tile or pipe, the sump pit, the discharge piping, and a pump or means of discharging water to natural grade.

(b) *Optional systems.* 1. If a complete drain tile or pipe system is not required by natural conditions under par. (a) or by a municipality or registered UDC inspection agency, a partial drain tile or pipe system may be installed.

2. For the purposes of this section, a partial drain tile or pipe system may include any of the elements under par. (a) 2.

(2) **OPTIONAL SYSTEMS.** (a) *New construction.* 1. For new dwelling construction, a municipality or registered UDC inspection agency may determine the soil types and natural or seasonal groundwater levels for which a complete drain tile or pipe system is required.

2. For new dwelling construction, a municipality may not enact requirements for other than complete drain tile or pipe systems.

(b) *Alterations to an existing dwelling.* For an alteration to an existing dwelling covered by this code, a municipality may not require a complete drain tile or pipe system.

(c) *Partial systems.* Municipalities may allow partial drain tile or pipe systems for new dwellings under construction or existing dwellings.

(3) **MATERIAL AND INSTALLATION REQUIREMENTS FOR REQUIRED SYSTEMS.** (a) *General.* Complete drain tile or pipe systems required by natural conditions under sub. (1) (a) or by a municipality or registered UDC inspection agency shall comply with the requirements of this subsection.

(b) *Basement floor slabs.* The basement slab shall be placed on at least 4 inches of clean graded sand, gravel or crushed stone.

(c) *Manufactured drainage systems.* Manufactured drainage systems not meeting the requirements of this section shall be submitted to the department for review and approval prior to installation.

(d) *Drain tile or pipe installation.* Drain tile or pipe used for foundation drainage shall comply with the following requirements:

1. Drain tile or pipe shall have an inside diameter of at least 3 inches.

2. Drain tile or pipe shall have open seams, joints or perforations to allow water to enter.

3. Where individual tiles are used, they shall be laid with 1/8 inch open joints. Joints between tiles shall be covered with a strip of asphalt or tar impregnated felt.

4. The tile or pipe shall be placed upon at least 2 inches of coarse aggregate and shall be covered on the top and the side fac-

ing away from the dwelling with at least 12 inches of coarse aggregate that meets all of the following criteria:

- 100% of the aggregate shall pass a 1-inch sieve.
- 90-100% of the aggregate shall pass a 3/4-inch sieve.
- 0-55% of the aggregate shall pass a 3/8-inch sieve.
- 0-5% of the aggregate shall pass a #8 sieve.

**Note:** A #8 sieve has square openings of 2.36 mm or 0.09 inch.

**Note:** These specifications encompass aggregate sizes #6 and #67 per ASTM standard C 33. Of the two sizes, #6 is coarser.

5. Bleeder tiles or pipes shall be provided at no more than 8-foot intervals to connect the exterior drain tile or pipe to the interior drain tile or pipe.

6. The drain tiles or pipe that lead from the footing tiles to the sump pit shall be laid at a grade of at least 1/8 inch per foot leading to the sump pit. The remaining drain tiles or pipe shall be level or graded downward to the line leading to the sump pit.

(e) *Drain tile or pipe discharge.* 1. Drain tiles or pipe shall be connected to the sump pit.

2. The sump pit shall discharge to natural grade or be equipped with a pump.

3. All other aspects of drain tile discharge shall be in accordance with the uniform plumbing code, chs. Comm 82 to 87.

**Note:** The following is a reprint of a pertinent section of the plumbing code:

**Comm 82.36 (8) SUMPS AND PUMPS.** (a) *Sumps.* 1. 'General.' All storm building subdrains shall discharge into a sump, the contents of which shall be automatically lifted and discharged, dispersed or used in accordance with sub. (4).

2. 'Construction and installation'. a. Except as provided in subd. 2. c. and d., an interior sump shall have a rim extending at least one inch above the floor immediately adjacent to the sump.

b. A sump shall have a removable cover of sufficient strength for anticipated loads.

c. Where a sump is installed in an exterior meter pit or elevator pit, the rim may be level with the floor.

d. When a sump is provided with an airtight, solid cover.

3. 'Location'. All sumps installed for the purpose of receiving clearwater, groundwater or stormwater shall be separated from water wells by the applicable separation distances contained in chs. NR 811 and 812, or as otherwise permitted by the department of natural resources.

**Note:** See Appendix A-82.30 (11) (d) for material reprinted from s. NR 812.08.

4. 'Size'. Except as recommended by the pump manufacturer, the size of each sump shall be no smaller than 16 inches in diameter at the top, 14 inches in diameter at the bottom, and 22 inches in depth.

(b) *Pumps.* 1. 'Size.' The pump shall be of a capacity appropriate for the anticipated use.

2. 'Discharge piping'. a. Where a pump discharges into a storm drain system, a check valve shall be installed.

b. The minimum diameter discharge piping shall be based on the design flow rate of the pump and a minimum velocity of one foot/second.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, February, 1985, No. 350, eff. 3-1-85; r. and recr. (3) (a) 3. and (4), Register, May, 1988, No. 389, eff. 6-1-88; am. (2) (f), Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. (4) (c) 3., Register, August, 1991, No. 428, eff. 9-1-91; cr. (5), Register, March, 1992, No. 435, eff. 4-1-92; r. and recr. Register, January, 1999, No. 517, eff. 2-1-99; am. (3) (d) 4., Register, March, 2001, No. 543, eff. 4-1-01; CR 03-097; am. (1) (b) 1., (2) (a) 1., and (3) (a) Register November 2004 No. 587, eff. 1-1-05.

## Subchapter V — Foundations

**Comm 21.18 Foundations. (1) GENERAL.** (a) *Design.* Foundation walls shall be designed and constructed to support the vertical loads of the dwelling, lateral soil pressure, and other loads without exceeding the allowable stresses of the materials of which the foundations are constructed.

(b) *Lateral support at base.* Lateral support such as floor slabs or framing shall be provided at the base of foundation walls.

(c) *Lateral support at top.* Lateral support shall be provided at the top of the foundation walls by one of the following:

2. Structural analysis. A system designed through structural analysis.

3. Anchor bolts. a. Structural steel anchor bolts, at least 1/2 inch in diameter, embedded at least 7 inches into the [concrete or] grouted masonry with a maximum spacing of 72 inches and located within 18 inches of wall corners.

b. A properly sized nut and washer shall be tightened on each bolt to the plate or sill.

c. When vertical-reinforcing steel is provided in masonry construction, as required under sub. (3), the location requirements



under subd. 3. a. shall be modified as necessary so anchor bolts are placed in the same core as the reinforcement without exceeding the limits of subd. 3. a.

4. Other mechanical fasteners. a. Mechanical fasteners used in accordance with the manufacturer's testing and listing.

b. When vertical-reinforcing steel is provided in masonry construction, as required under sub. (3), the location requirements under subd. 4. a. shall be modified as necessary so the fasteners are placed in the same core as the reinforcement without exceeding the limits of subd. 4. a.

(d) *Floor framing*. 1. Floor framing shall be fastened to the sill plate by one of the following methods:

a. Mechanical fasteners used in accordance with the manufacturer's testing and listing.

b. In accordance with structural analysis.

c. In accordance with the fastener table printed in the appendix to this code.

2. a. Where the floor framing is parallel to the foundation wall, solid blocking or bridging shall be installed in at least the first adjacent joist space at a spacing of no more than 32 inches on center.

b. Solid blocking shall be of the same depth as the joist.

c. Fastening of the blocking or bridging shall be in accordance with structural analysis or the fastener table printed in the appendix to this code.

(e) *Soil lateral load*. Unless designed through structural analysis, soil lateral loads shall be determined from Table 21.18-A.

**TABLE 21.18-A  
SOIL LATERAL LOAD**

Description of Backfill Material <sup>e</sup>	Unified Soil Classification	Design Lateral Soil Load <sup>a</sup> PSF per Foot of Depth
Well graded, clean gravels; gravel-sand mixes	GW	30 <sup>c</sup>
Poorly graded clean gravels; gravel-sand mixes	GP	30 <sup>c</sup>
Silty gravels, poorly graded gravel-sand mixes	GM	40 <sup>c</sup>
Clayey gravels, poorly graded gravel-and-clay mixes	GC	45 <sup>c</sup>
Well-graded, clean sands; gravelly sand mixes	SW	30 <sup>c</sup>
Poorly graded clean sands; sand-gravel mixes	SP	30 <sup>c</sup>
Silty sands, poorly graded sand-silt mixes	SM	45 <sup>c</sup>
Sand-silt clay mix with plastic fines	SM-SC	45 <sup>d</sup>
Clayey sands, poorly graded sand-clay mixes	SC	60 <sup>d</sup>
Inorganic silts and clayey silts	ML	45 <sup>d</sup>
Mixture of inorganic silt and clay	ML-CL	60 <sup>d</sup>
Inorganic clays of low to medium plasticity	CL	60 <sup>d</sup>
Organic silts and silt clays, low plasticity	OL	b
Inorganic clayey silts, elastic silts	MH	60 <sup>d</sup>
Inorganic clays of high plasticity	CH	b
Organic clays and silty clays	OH	b

<sup>a</sup>Design lateral soil loads are given for moist conditions for the specified soils at their optimum densities. Actual field conditions shall govern. Submerged or saturated soil pressures shall include the weight of the buoyant soil plus the hydrostatic loads.

<sup>b</sup>Unsuitable as backfill material.

<sup>c</sup>For relatively rigid walls, as when braced by floors, the design lateral soil load shall be increased for sand and gravel type soils to 60 psf per foot of depth. Basement walls extending not more than 8 feet below grade and supporting flexible floor systems are not considered relatively rigid walls.

<sup>d</sup>For relatively rigid walls, as when braced by floors, the design lateral load shall be increased for silt and clay type soils to 100 psf per foot of depth. Basement walls extending not more than 8 feet below grade and supporting flexible floor systems are not considered relatively rigid walls.

<sup>e</sup>Soil classes are in accordance with the Unified Soil Classification System, ASTM D2487, and design lateral loads are for moist soil conditions without hydrostatic pressure.

(2) **CONCRETE FOUNDATION WALLS.** (a) Except as provided in par. (b), unless designed through structural analysis, the minimum thickness of concrete foundation walls shall be determined from

Table 21.18-B, but in no case shall the thickness of the foundation wall be less than the thickness of the wall it supports.

(b) A 6-inch nominal wall thickness may be used provided the fill on one side of the wall is within 12 inches vertically of the fill on the other side of the wall.

**TABLE 21.18-B  
CONCRETE WALL THICKNESSES**

Type of Concrete	Nominal Thickness (inches)	Maximum Height of Unbalanced Fill <sup>1</sup> for Material of Wall Being Supported (Wood frame - feet)
3000 psi	8	8
Unreinforced concrete	10	9
	12 <sup>2</sup>	10
	14	11.5

<sup>1</sup>Unbalanced fill is the difference in elevation between the outside grade and the basement floor.

<sup>2</sup>The maximum height of unbalanced fill for a 12-inch thick plain concrete wall may be increased to 12 feet provided the wall is constructed of concrete with a minimum compressive value of 6,000 psi at 28 days.

(3) **MASONRY FOUNDATION WALLS.** (a) *Dampproofing.* Masonry foundation walls shall be dampproofed by applying to the exterior surface from footing to finished grade, a continuous coating of one of the following:

1. Portland cement and sand coat mortar, at least 3/8 inch thick.

2. Type M or S mortar, at least 3/8 inch thick.

3. Structural surface bonding material, at least 1/4 inch thick.

4. Equivalent dampproofing material, applied in accordance with the manufacturer's instructions and acceptable to the department.

(b) *Structural requirements.* Unless designed through structural analysis, the masonry foundation walls shall be constructed in accordance with ACI 530.1 and the following requirements:

1. The minimum thickness of unreinforced masonry foundation walls shall be determined by Table 21.18-C, but in no case shall the thickness be less than the thickness of the wall it supports.

**TABLE 21.18-C  
PLAIN MASONRY FOUNDATION WALLS<sup>d</sup>**

Maximum Wall Height (ft-in)	Depth of unbalanced backfill height (ft)	Minimum nominal wall thickness (inches)		
		Soil classes and lateral soil load <sup>a</sup> (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, MH, ML-CL and inorganic CL soils 60
7-8	4 (or less)	8	8	8
	5	8	10	10
	6	10	12	10 (solid <sup>b</sup> )
	7	12	10 (solid <sup>b</sup> )	12 (solid <sup>b</sup> )
8-4	4 (or less)	8	8	8
	5	8	10	12
	6	10	12	12 (solid <sup>b</sup> )
	7	12	12 (solid <sup>b</sup> )	Note c
9-1	4 (or less)	8	8	8
	5	8	10	12
	6	12	12	12 (solid <sup>b</sup> )
	7	12 (solid <sup>b</sup> )	12 (solid <sup>b</sup> )	Note c
8		12 (solid <sup>b</sup> )	Note c	Note c
		Note c	Note c	Note c
		Note c	Note c	Note c

<sup>a</sup>For design lateral soils and descriptions of soil classes, see s. Comm 21.18 (1) (d). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

<sup>b</sup>Solid grouted hollow units.

<sup>c</sup>An analysis in compliance with ACI 530 or reinforcement in accordance with Table 21.18-D, 21.18-E or 21.18-F is required.

<sup>d</sup>Mortar shall be Type M or S and masonry shall be laid in running bond.

2. Reinforced masonry walls shall be reinforced in accordance with the requirements of Tables 21.18-D, 21.18-E or 21.18-F. Vertical reinforcement shall be provided on each side of any opening and at intervals indicated in the appropriate table.



TABLE 21.18–D<sup>b,c,d</sup>

8, 10 OR 12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE  $d \geq 5$  in.<sup>e</sup>

Maximum Wall Height (ft-in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load <sup>a</sup> (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, MH, ML-CL and inorganic CL soils 60
7-8	4 (or less)	#4 at 48" o.c.	#4 at 48" o.c.	#4 at 48" o.c.
	5	#4 at 48" o.c.	#4 at 48" o.c.	#4 at 40" o.c.
	6	#4 at 48" o.c.	#5 at 48" o.c.	#5 at 40" o.c.
	7	#4 at 40" o.c.	#5 at 40" o.c.	#6 at 48" o.c.
8-4	4 (or less)	#4 at 48" o.c.	#4 at 48" o.c.	#4 at 48" o.c.
	5	#4 at 48" o.c.	#4 at 48" o.c.	#4 at 40" o.c.
	6	#4 at 48" o.c.	#5 at 48" o.c.	#5 at 40" o.c.
	7	#5 at 48" o.c.	#6 at 48" o.c.	#6 at 40" o.c.
9-1	4 (or less)	#4 at 48" o.c.	#4 at 48" o.c.	#4 at 48" o.c.
	5	#4 at 48" o.c.	#4 at 48" o.c.	#5 at 48" o.c.
	6	#4 at 48" o.c.	#5 at 48" o.c.	#6 at 48" o.c.
	7	#5 at 48" o.c.	#6 at 48" o.c.	#7 at 48" o.c.
	8	#5 at 40" o.c.	#7 at 48" o.c.	#8 at 48" o.c.
	9	#6 at 40" o.c.	#8 at 48" o.c.	#8 at 32" o.c.

<sup>a</sup>For design lateral soil loads, see s. Comm 21.18 (1) (d). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

<sup>b</sup>Provisions for this table are based on construction requirements specified in s. Comm 21.18 (3) (b).

<sup>c</sup>For alternative reinforcement, see s. Comm 21.18 (3) (b).

<sup>d</sup>Mortar shall be Type M or S and masonry shall be laid in running bond.

<sup>e</sup>The specified location of the reinforcement shall equal or exceed the effective depth distance, *d*, measured from the face of the soil side of the wall to the center of vertical reinforcement.

TABLE 21.18–E<sup>b,c,d</sup>

10 OR 12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE  $d \geq 6.75$  in.<sup>e</sup>

Maximum Wall Height (ft-in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load <sup>a</sup> (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, MH, ML-CL and inorganic CL soils 60
7-8	4 (or less)	#4 at 56" o.c.	#4 at 56" o.c.	#4 at 56" o.c.
	5	#4 at 56" o.c.	#4 at 56" o.c.	#4 at 56" o.c.
	6	#4 at 56" o.c.	#4 at 48" o.c.	#4 at 40" o.c.
	7	#4 at 56" o.c.	#5 at 56" o.c.	#5 at 40" o.c.
8-4	4 (or less)	#4 at 56" o.c.	#4 at 56" o.c.	#4 at 56" o.c.
	5	#4 at 56" o.c.	#4 at 56" o.c.	#4 at 48" o.c.
	6	#4 at 56" o.c.	#4 at 48" o.c.	#5 at 56" o.c.
	7	#4 at 48" o.c.	#4 at 32" o.c.	#6 at 56" o.c.
9-1	4 (or less)	#4 at 56" o.c.	#4 at 56" o.c.	#4 at 56" o.c.
	5	#4 at 56" o.c.	#4 at 56" o.c.	#4 at 48" o.c.
	6	#4 at 56" o.c.	#4 at 40" o.c.	#4 at 32" o.c.
	7	#4 at 40" o.c.	#5 at 48" o.c.	#6 at 48" o.c.
	8	#4 at 32" o.c.	#6 at 48" o.c.	#4 at 16" o.c.
	9	#5 at 40" o.c.	#6 at 40" o.c.	#7 at 40" o.c.

<sup>a</sup>For design lateral soil loads, see s. Comm 21.18 (1) (d). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

<sup>b</sup>Provisions for this table are based on construction requirements specified in s. Comm 21.18 (3) (b).

<sup>c</sup>For alternative reinforcement, see s. Comm 21.18 (3) (b).

<sup>d</sup>Mortar shall be Type M or S and masonry shall be laid in running bond.

<sup>e</sup>The specified location of the reinforcement shall equal or exceed the effective depth distance, *d*, measured from the face of the soil side of the wall to the center of vertical reinforcement.

TABLE 21.18–F<sup>b,c,d</sup>

12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE  $d \geq 8.75$  in.<sup>e</sup>

Maximum Wall Height (ft-in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load <sup>a</sup> (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, MH, ML-CL and inorganic CL soils 60
7-8	4 (or less)	#4 at 72" o.c.	#4 at 72" o.c.	#4 at 72" o.c.
	5	#4 at 72" o.c.	#4 at 72" o.c.	#4 at 72" o.c.
	6	#4 at 72" o.c.	#4 at 64" o.c.	#4 at 48" o.c.
	7	#4 at 72" o.c.	#4 at 48" o.c.	#5 at 56" o.c.
8-4	4 (or less)	#4 at 72" o.c.	#4 at 72" o.c.	#4 at 72" o.c.
	5	#4 at 72" o.c.	#4 at 72" o.c.	#4 at 72" o.c.
	6	#4 at 72" o.c.	#4 at 56" o.c.	#5 at 72" o.c.
	7	#4 at 64" o.c.	#5 at 64" o.c.	#4 at 32" o.c.
9-1	4 (or less)	#4 at 72" o.c.	#4 at 72" o.c.	#4 at 72" o.c.
	5	#4 at 72" o.c.	#4 at 72" o.c.	#4 at 64" o.c.
	6	#4 at 72" o.c.	#4 at 56" o.c.	#5 at 64" o.c.
	7	#4 at 56" o.c.	#4 at 40" o.c.	#6 at 64" o.c.
	8	#4 at 40" o.c.	#6 at 40" o.c.	#6 at 48" o.c.
	9	#5 at 56" o.c.	#7 at 72" o.c.	#6 at 40" o.c.

<sup>a</sup>For design lateral soil loads, see s. Comm 21.18 (1) (d). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.

<sup>b</sup>Provisions for this table are based on construction requirements specified in s. Comm 21.18 (3) (b).

<sup>c</sup>For alternative reinforcement, see s. Comm 21.18 (3) (b).

<sup>d</sup>Mortar shall be Type M or S and masonry shall be laid in running bond.

<sup>e</sup>The specified location of the reinforcement shall equal or exceed the effective depth distance, *d*, measured from the face of the soil side of the wall to the center of vertical reinforcement.

3. Vertical reinforcement shall have a minimum yield strength of 60,000 psi.

4. Solid-grouted hollow units or cores containing vertical reinforcement shall be filled with masonry grout that complies with ASTM C 476.

5. In lieu of the reinforcement provisions of Tables 21.18–D, 21.18–E and 21.18–F, alternative reinforcing bar size and spacing having an equivalent cross-sectional area or reinforcement per linear foot of wall is permitted, provided the spacing of the reinforcement does not exceed 72 inches and reinforcing bar size does not exceed No. 11.

6. The depth below grade, wall height and reinforcement spacing may exceed the maximum values indicated in Tables 21.18–D, 21.18–E and 21.18–F only if the design is based on structural analysis.

(4) WOOD FOUNDATIONS. Wood foundations shall be designed and constructed in accordance with "The Permanent Wood Foundation System, Basic Requirements, Technical Report No. 7", as adopted under s. Comm 20.24, Table 20.24–2 and the following exception. The thickness of the foundation wall shall be no less than the thickness of the wall it supports.

(a) Exception. Fasteners shall be of silicon bronze, copper or stainless steel types 304 or 316.

Note: Additional explanatory information regarding wood foundations can be obtained in "All-Weather Wood Foundation Systems, Design, Fabrication, Installation Manual", published by the American Forest & Paper Association.

(b) Materials. All lumber and plywood shall be pressure treated with preservative and labeled to show conformance with AWWA C–22.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (3) (intro), Register, February, 1985, No. 350, eff. 3–1–85; cr. (2) (c) to (e), r. and recr. Tables C and D, r. (3) (a) 2., renum. (3) (a) 1. to be (a), Register, January, 1989, No. 397, eff. 2–1–89; am. (intro.), (2) (b), (3) (b) and Table 21.18–D, cr. Table 21.18, r. (2) (c), renum. (2) (d) and (e) to be (2) (c) and (d), Register, March, 1992, No. 435, eff.

4-1-92; renum. (1) to (3) to be (2) to (4), and am. (3) (b), (4) (intro.) and (b), Table 21.18-A, r. (intro.) and Table 21.18, cr. (1), (3) (e), Register, November, 1995, No. 479, eff. 12-1-95; am (2), Register, January, 1999, No. 517, eff. 2-1-99; r. and recr. (1) (b), (3), Tables 21.18-C and D, am. (2) (a), r. Table 21.18-B, renum. Table 21.18-A to be Table 21.18-B and cr. (1) (c), (d), Tables 21.18-A, E and F, Register March 2001 No. 543, eff. 4-1-01; CR 02-077: r. (1) (c) 1., renum. (1) (d) to be (1) (e), cr. (1) (d), am. (4) (intro.), (b) and Tables 21.18-A, C and F Register May 2003 No. 569, eff. 8-1-03.

## Subchapter VI — Floors

**Comm 21.19 Floor design.** Floors shall support all dead loads plus the minimum unit live loads as set forth in s. Comm 21.02. The live loads shall be applied to act vertically and uniformly to each square foot of horizontal floor area. Basements shall be provided with wood or concrete or similar type floors that comply with s. Comm 21.20 or 21.205.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr., Register, March, 1992, No. 435, eff. 4-1-92.

**Comm 21.20 Concrete floors.** (1) When concrete floors are provided, the thickness of the concrete shall measure at least 3 inches.

(2) When a concrete floor is placed in clay soils, a 4-inch thick base course shall be placed in the subgrade consisting of clean graded sand, gravel or crushed stone.

(3) When a concrete floor is placed on sand or gravel soils, the base course may be omitted unless drain tile is installed. If drain tile is installed, the requirements of s. Comm 21.17 shall be met.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. Register, January, 1999, No. 517, eff. 2-1-99.

**Comm 21.203 Garage floors.** (1) **MATERIALS.** Garage floors shall be constructed of concrete or other noncombustible materials which are impermeable to petroleum products. Slab-on-grade concrete garage floors shall be at least 4 inches thick and placed over at least 4 inches of granular fill.

**Note:** It is not the intent of sub. (1) to require a concrete floor to be sealed to make it completely impermeable.

(2) **CONFIGURATION.** The floor shall be sloped such that water is removed in accordance with one of the following:

(a) Water drains toward the overhead door or to exterior grade such that no damage will be caused to any structural member or wall covering of the garage or the dwelling.

(b) Water drains into an interior floor drain that complies with the requirements of ch. Comm 82.

**Note:** See s. Comm 82.34 for floor drain requirements.

**History:** Cr. Register, November, 1995, No. 479, eff. 12-1-95; CR 02-077: r. and recr. (2) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.205 Wood floors in contact with the ground.** Wood floors in contact with the ground shall comply with the requirements under s. Comm 21.18 (4).

**History:** Cr. Register, January, 1989, No. 397, eff. 2-1-89; am. Register, January, 1999, No. 517, eff. 2-1-99; correction made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 02-077: r. and recr. Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.21 Precast concrete floors.** Precast concrete floors shall be designed through structural analysis, or load tables furnished by the precast product fabricator may be used, provided the load tables were developed using structural analysis or load testing.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, March, 1992, No. 435, eff. 4-1-92.

**Comm 21.22 Wood frame floors.** Unless designed through structural analysis, wood frame floors shall comply with the following requirements:

(1) **FLOOR JOISTS.** Wood floor joists shall comply with the requirements of s. Comm 21.02 (3) (a). The minimum live loads shall be determined from s. Comm 21.02. Where sill plates are provided, the sill plates shall be fastened to the foundation. Double floor joists shall be provided underneath all bearing walls which are parallel to the floor joists.

(1m) **FLOOR JOISTS ON MASONRY WALLS.** (a) On masonry walls, the floor joists shall rest upon one of the following:

1. A mortar-filled or grout-filled core masonry block.
2. A solid-top masonry block.
3. A sill plate at least as wide as the nominal width of the wall.

**Note:** See s. Comm 21.10 for treatment requirements for wood in contact with masonry.

(2) **FLOOR TRUSSES.** Metal plate connected wood floor trusses shall be designed in accordance with the Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses and the National Design Specification for Wood Construction. Truss members shall not be cut, bored or notched.

(3) **GIRDERS AND BEAMS.** Girders and beams shall be selected from Table 21.22-A1 or Table 21.22-A2 or shall be designed through structural analysis.

(a) Wood girders and beams shall be fitted at the post or column. Adjoining ends shall be fastened to each other to transfer horizontal loads across the joint. Beams shall also be fastened to the posts with framing anchors, angle clips, or equivalent.

(b) Where intermediate beams are used, they shall rest on top of the girders; or shall be supported by ledgers or blocks fastened to the sides of the girders; or they may be supported by approved metal hangers into which the ends of the beams shall be fitted.

(4) **BEARING AND END CONFIGURATION.** (a) *Sawn lumber.* 1. 'Joists.' Wood joists made of sawn lumber shall meet the following bearing requirements:

a. Wood joists supported on wood or metal shall have a bearing surface of at least 1½-inches measured from the end of the joist.

b. Wood joists supported on masonry or concrete shall have a bearing surface of at least 3 inches measured from the end of the joist.

c. The tail end of a floor joist may not extend past the edge of a beam by more than the depth of the floor joist.

d. Wood floor joists with ends that intersect over a beam shall have the ends overlap at least 3 inches and be securely fastened together with at least two 12d common nails or the ends shall be butt-jointed or face-jointed and fastened with ties, straps, plates or solid blocking.

2. 'Beams and girders.' Beams and girders made of sawn lumber shall have a bearing surface on their supports of at least 3 inches parallel to the beam or girder and be at least as wide as the beam or girder.

(b) *Engineered wood products.* Bearing surface for engineered wood products shall be in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing and are applicable to the configuration.

(5) **NOTCHING AND BORING.** Notching and boring of beams or girders is prohibited unless determined through structural analysis.

(a) *Notching of floor joists.* 1. Notches located in the top or bottom of floor joists shall not have a depth exceeding 1/6 the depth of the joist, shall not have a length exceeding 1/3 the joist depth nor be located in the middle 1/3 of the span of the joist.

2. Where floor joists are notched on the ends, the notch shall not exceed 1/4 the depth of the joist. Notches over supports may extend the full bearing width of the support.

(b) *Boring of floor joists.* 1. 'General.' A hole may not be bored in a floor joist within 2 inches of a notch or another hole. In no case shall the distance between adjacent holes be less than the diameter of the larger hole.

2. 'Holes near the edge.' Holes bored in the top or bottom 2 inches of a joist shall follow the limitations for notching under par. (a).

3. 'Other holes.' Holes bored in floor joists that are not within 2 inches of the top or bottom of the joist shall have their diameter limited to 1/3 the depth of the joist.

(c) *Engineered wood products.* Notching or boring of engineered wood products shall be done in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing.

**(6) OVERHANG OF FLOORS.** (a) *General.* Except as provided in pars. (b) and (c), a floor joist overhang shall be cantilevered beyond the outer edge of the supporting wall below it by no more than the actual depth of the joist or shall be designed through structural analysis in accordance with s. Comm 21.02 (3).

(b) *Joist overhangs parallel to the main floor framing system.* Joist overhangs that are extensions of, and parallel to, the main floor framing system may extend beyond the depth of the joist without structural analysis provided they meet all of the following conditions:

1. The overhang is cantilevered no more than 2 feet beyond the outer edge of the supporting wall below it.
2. a. The overhang supports a uniform load limited to the weight of the bearing wall and the tributary roof area above it.
- b. The tributary length of the roof area, excluding the eave overhang, is no more than 2 feet greater than the actual length of the joist directly below.
- c. The eave overhang is no more than 2 feet.

**Note:** The tributary length is usually half the span of the joist or rafter.

3. The joist overhang does not support any concentrated loads. For the purposes of this subsection, a framed opening in the wall with a rough opening of 4 feet or less shall be considered uniform loading.

4. a. The cantilevered joist is doubled at the supporting wall.
- b. The doubled joist length extends inward beyond the inner edge of the supporting wall by the same distance as the cantilever.
- c. The added joist member is secured to the main joist as

stated in the nailing schedule in the appendix, under the heading for "floor framing, built-up girder and beams, top loaded".

(c) *Joist overhangs perpendicular to the main floor framing system.* Joist overhangs that are perpendicular to the main floor framing system, or lookout joists, may extend beyond the depth of the joist without structural analysis provided they meet all of the following conditions:

1. The joist overhang is cantilevered no more than 2 feet beyond the outer edge of the supporting wall below it.
2. a. A double floor joist is used to support the lookout joist.
- b. The double floor joist is located a distance of at least 2 times the cantilever length inward from the outer edge of the supporting wall below.
- c. The lookout joists are fastened to the double joist with metal hangers.
3. The joist overhang supports no more than either a non-bearing wall or a wall that supports only a roof which spans no more than the floor overhang cantilever length plus the eave overhang.

(d) All overhangs longer than the depth of the supporting joist that do not meet all of the conditions under par. (b) or (c) shall be designed through structural analysis.

**(7) FLOOR OPENINGS.** Trimmers and headers shall be doubled when the span of the header exceeds 4 feet. Headers which span more than 6 feet shall have the ends supported by joist hangers or framing anchors, unless the ends are supported on a partition or beam. Tail joists (joists which frame into headers) more than 8 feet long shall be supported on metal framing anchors or on ledger strips of at least 2 inches by 2 inches nominal.

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TABLE 21.22-A1  
MINIMUM SIZES FOR BEAMS AND GIRDERS OF STEEL OR WOOD

Column Spacing	One Floor Only		Roof/Ceiling and One Floor		Roof/Ceiling+ One Floor/Ceiling + One Floor				
	Wood Beams <sup>1</sup> (in., nominal)	A 36 Steel Beams <sup>2</sup>	Wood Beams <sup>1,3</sup> (in., nominal)	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2
24 ft. wide house:									
8 ft.	8x8	—	10x10	—	—	8x12	10x12	8x12	10x12
			6x12	—	—	6x14	8x14	6x14	8x14
10 ft.	8x10	—	10x12	—	—	8x12	10x14	10x14	10x14
			8x14	—	—	8x16	8x16	8x16	8x16
12 ft.	8x12	—	10x14	—	—	12x12	14x14	14x14	14x14
			8x16	—	—	10x14	12x16	10x16	12x16
15 ft.	12x12	—	—	—	—	—	—	—	—
			—	—	—	—	—	—	—
26 ft. wide house:									
8 ft.	6x10	—	10x10	—	—	10x12	10x12	10x12	10x12
			8x12	—	—	8x14	8x14	8x14	8x14
10 ft.	10x10	—	10x12	—	—	10x14	12x14	10x14	12x14
			8x14	—	—	8x16	8x16	8x16	8x16
12 ft.	8x12	—	10x14	—	—	12x12	12x16	12x16	12x16
			8x16	—	—	—	—	—	—
15 ft.	10x14	—	—	—	—	—	—	—	—
			—	—	—	—	—	—	—
28 ft. wide house:									
8 ft.	6x10	—	8x12	—	—	10x12	10x12	10x12	10x12
			4x16	—	—	8x14	8x14	8x14	8x14
10 ft.	10x10	M 10x7.5	10x12	—	—	12x12	12x14	12x14	12x14
		W 6x9	8x14	—	—	8x16	10x16	8x16	10x16
12 ft.	10x12	M 10x9	12x14	—	—	12x14	12x16	12x16	12x16
		W 6x12	10x16	—	—	10x18	10x18	10x18	10x18
15 ft.	10x14	M 12x10	—	—	—	—	—	—	—
		W 8x13	—	—	—	—	—	—	—
30 ft. wide house:									
8 ft.	8x10	—	8x12	—	—	10x12	12x12	10x12	12x12
			6x14	—	—	8x14	8x14	8x14	8x14
10 ft.	10x10	M 10x7.5	10x12	—	—	12x14	12x14	12x14	12x14
		W 6x9	8x14	—	—	10x16	10x16	10x16	10x16
12 ft.	10x12	M 10x9	12x14	—	—	12x14	14x16	12x16	14x18
		W 6x12	10x16	—	—	10x18	12x18	10x18	12x18
15 ft.	12x14	M 12x11.8	—	—	—	—	—	—	—
		W 8x15	—	—	—	—	—	—	—
32 ft. wide house:									
8 ft.	8x10	—	8x12	—	—	12x12	12x12	12x12	12x12
			6x14	—	—	8x14	10x14	8x14	10x14
10 ft.	10x10	M 10x7.5	12x12	—	—	12x14	14x14	12x14	14x14
		W 6x9	8x14	—	—	10x16	10x16	10x16	10x16
12 ft.	10x12	M 10x9	12x14	—	—	14x14	14x16	14x16	14x16
		W 6x12	10x16	—	—	12x18	12x18	12x18	12x18
15 ft.	12x14	M 12x11.8	—	—	—	—	—	—	—
		W 8x15	—	—	—	—	—	—	—

<sup>1</sup>This table is based upon wood with a fiber bending stress of 1,000 psi. Two acceptable wood beam selections are listed for each loading condition.

<sup>2</sup>Two acceptable steel beam selections are listed for each loading condition. The first entry is the most economical selection based upon beam weight.

<sup>3</sup>Wood main beams or girders may be built up from nominal 2-inch members. The 2-inch members shall be laid on edge and fastened together with a double row of common nails not less than 3 1/2-inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece. Where built-up beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

WISCONSIN ADMINISTRATIVE CODE

TABLE 21.22-A2  
 MINIMUM SIZES FOR BUILT-UP WOOD BEAMS IN BASEMENTS AND CRAWL SPACES SUPPORTING ONE FLOOR ONLY

HOUSE WIDTH	F <sub>b</sub> =800 psi		F <sub>b</sub> =1000 psi		F <sub>b</sub> =1200 psi		F <sub>b</sub> =1400 psi		
	Col. Spacing ft-in	Beam size	Col. Spacing ft-in	Beam size	Col. Spacing ft-in	Beam size	Col. Spacing ft-in	Beam size	
16 ft.	7-8	3-2x8	8-7	3-2x8	9-4	3-2x8	10-2	3-2x8	
	8-11	4-2x8	9-11	4-2x8	10-11	4-2x8	11-10	4-2x8	
	9-11	3-2x10	11-1	3-2x10	12-1	3-2x10	13-1	3-2x10	
	11-4	4-2x10	12-8	4-2x10	13-1	4-2x10	15-0	4-2x10	
	12-0	3-2x12	13-5	3-2x12	14-8	3-2x12	15-10	3-2x12	
	13-10	4-2x12	15-7	4-2x12	17-0	4-2x12	18-4	4-2x12	
	20 ft.	6-11	3-2x8	7-8	3-2x8	8-5	3-2x8	9-1	3-2x8
		7-11	4-2x8	8-11	4-2x8	9-9	4-2x8	10-7	4-2x8
		8-10	3-2x10	9-11	3-2x10	10-10	3-2x10	11-8	3-2x10
		10-2	4-2x10	11-4	4-2x10	12-6	4-2x10	13-6	4-2x10
		10-9	3-2x12	12-0	3-2x12	13-2	3-2x12	14-3	3-2x12
		11-5	4-2x12	13-11	4-2x12	15-2	4-2x12	16-5	4-2x12
		24 ft.	6-3	3-2x8	7-1	3-2x8	7-8	3-2x8	8-4
7-3			4-2x8	8-2	4-2x8	8-11	4-2x8	9-8	4-2x8
8-1			3-2x10	9-0	3-2x10	9-11	3-2x10	10-8	3-2x10
9-4			4-2x10	10-4	4-2x10	11-5	4-2x10	12-4	4-2x10
9-9			3-2x12	10-11	3-2x12	12-0	3-2x12	12-11	3-2x12
11-3			4-2x12	12-7	4-2x12	13-11	4-2x12	15-0	4-2x12
28 ft.			5-10	3-2x8	6-6	3-2x8	7-2	3-2x8	7-8
	6-8		4-2x8	7-6	4-2x8	8-3	4-2x8	8-11	4-2x8
	7-5		3-2x10	8-4	3-2x10	9-1	3-2x10	9-11	3-2x10
	8-7		4-2x10	9-8	4-2x10	10-6	4-2x10	11-4	4-2x10
	9-0		3-2x12	10-1	3-2x12	11-1	3-2x12	10-11	3-2x12
	10-5		4-2x12	11-8	4-2x12	12-10	4-2x12	13-10	4-2x12
	32 ft.		5-4	3-2x8	6-1	3-2x8	6-8	3-2x8	7-3
		6-3	4-2x8	7-1	4-2x8	7-8	4-2x8	8-4	4-2x8
		7-0	3-2x10	7-9	3-2x10	8-7	3-2x10	9-2	3-2x10
		8-1	4-2x10	8-11	4-2x10	9-10	4-2x10	10-8	4-2x10
		8-5	3-2x12	9-6	3-2x12	10-4	3-2x12	11-1	3-2x12
		9-9	4-2x12	11-0	4-2x12	12-0	4-2x12	12-11	4-2x12
		36 ft.	5-1	3-2x8	5-9	3-2x8	6-3	3-2x8	6-9
5-11			4-2x8	6-7	4-2x8	6-9	4-2x8	7-10	4-2x8
6-6			3-2x10	7-4	3-2x10	8-1	3-2x10	8-8	3-2x10
7-6			4-2x10	8-6	4-2x10	9-4	4-2x10	10-0	4-2x10
7-11			3-2x12	8-11	3-2x12	9-9	3-2x12	10-7	3-2x12
9-2			4-2x12	10-4	4-2x12	11-4	4-2x12	12-4	4-2x12

<sup>1</sup>This table provides maximum allowable spans in feet and inches for main beams or girders which are built-up from nominal 2-inch members.

<sup>2</sup>Fiber bending stress for various species and grades of wood is given in Appendix A21.

<sup>3</sup>The 2-inch members shall be laid on edge and fastened together with a double row of common nails not less than 3 1/2-inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece.

<sup>4</sup>Where built-up wood beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

<sup>5</sup>Where built-up wood beams are continued over more than one span and where lengths of individual pieces are less than the total length of the complete beam, butt joints shall be located over supports or within 6 inches of the quarter points of the clear span. Where located near the quarter points, the joints in built-up beams shall be separated by at least one lamination and shall not exceed the beam width.

(8) FLOOR SHEATHING, BOARDS AND PLANKS. (a) *Plywood sheathing*. Plywood sheathing used for floors shall be limited to the allowable loads and spans shown in Table 21.22–B.

(b) *Plywood underlayment*. Plywood underlayment shall be installed in accordance with Table 21.22–C.

(c) *Combination subfloor – underlayment*. Combination subfloor–underlayment shall be installed in accordance with Table 21.22–D.

(d) *Floor boards*. Where wood boards are used for floor sheathing, the boards shall comply with the minimum thicknesses shown in Table 21.22–E.

(e) *Planks*. Planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness. Planks shall terminate over beams unless the joints are end matched. The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be nailed to each beam.

(9) BRIDGING. (a) *Sawn lumber*. Bridging shall be provided for sawn lumber framing at intervals not exceeding 8 feet where the nominal depth to thickness ratio is greater than 4 to 1.

(b) *Engineered products*. Bridging shall be provided for engineered framing products in accordance with the manufacturer’s recommendations.

**TABLE 21.22–B**

**ALLOWABLE SPANS FOR PLYWOOD FLOOR SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS<sup>1</sup>**

Span Rating <sup>2</sup>	Plywood Thickness (in inches)	Maximum span <sup>3</sup> (in inches)
32/16	15/32, 1/2, 5/8	16 <sup>5</sup>
40/20	19/32, 5/8, 3/4, 7/8	20 <sup>4,5</sup>
48/24	23/32, 3/4, 7/8	24

<sup>1</sup>These values apply to C–D, C–C, and Structural I and II grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.

<sup>2</sup>Span Rating appears on all panels in the construction grades listed in footnote 1.

<sup>3</sup>Plywood edges shall have approved tongue and groove joints or shall be supported with blocking, unless 1/4–inch minimum thickness underlayment or 1 1/2 inches of approved cellular or lightweight concrete is installed or finished floor is 2 5/32–inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 165 pounds per square foot.

<sup>4</sup>For joists spaced 24 inches on center, plywood sheathing with Span Rating 40/20 or greater can be used for subfloors when supporting 1 1/2 inches lightweight concrete.

<sup>5</sup>May be 24 inches if 2 5/32–inch wood strip flooring is installed at right angles to joists.

**TABLE 21.22–C**

**MINIMUM THICKNESS FOR PLYWOOD UNDERLAYMENT**

Plywood Grades and Species Group	Application <sup>1</sup>	Minimum Plywood Thickness (inches)
Groups 1, 2, 3, 4, 5 APA	Over Smooth Subfloor	1/4
UNDERLAYMENT INT (with interior or exterior glue) APA UNDERLAYMENT EXT APA C–C Plugged EXT	Over Lumber Subfloor or Other Uneven Surfaces	1 1/32
Same Grades as Above But Group I Only	Over Lumber Floor Up to 4” Wide. Face Grain Must Be Perpendicular to Boards	1/4
APA UNDERLAYMENT Sanded Exterior Grade	Over 16” Joist Spacing, 19/32 Subfloor, Under Tile With Organic Adhesive	1 1/32
	Over 16” Joist Spacing, 19/32 Subfloor, Under Tile With Epoxy Mortar	1 5/32

<sup>1</sup>Place face grain across supports and end joints over framing.

<sup>2</sup>Leave 1/4” space at panel ends and edges, trim panels as necessary to maintain end spacing and panel support on framing. Fill joints with epoxy mortar. With single layer floors, use solid lumber backing or framing under all panel and edge joints, including T & G joints.

**TABLE 21.22–D**

**MINIMUM THICKNESS FOR PLYWOOD COMBINATION SUBFLOOR–UNDERLAYMENT, PLYWOOD CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS<sup>1,2</sup>**

Plywood Grade	Plywood Species Group	Maximum Support Spacing <sup>3</sup>		
		16” o.c.	20” o.c.	24” o.c.
Sanded	1	1/2	5/8	3/4
	2 & 3	5/8	3/4	7/8
exterior type	4	3/4	7/8	1
Underlayment C–C Plugged Sturd–I–Floor <sup>4</sup>	All Groups	APA Rated Sheathing and APA Rated Sturd–I–Floor shall be installed consistent with their rating.		

<sup>1</sup>Spans shall be limited to values shown, based on possible effect of concentrated loads.

<sup>2</sup>Unsupported edges shall be tongue and groove or blocked except where 1/4–inch underlayment or 2 5/32–inch finish floor is used.

<sup>3</sup>Underlayment, C–C Plugged, sanded exterior type: allowable uniform load based on deflection of L/360 span for spans 24 inches or less is 125 psf; and for spans 48 inches, 65 psf.

<sup>4</sup>The department will accept subfloor underlayment panels such as Sturd–I–Floor which meet the requirements of APA manufacturing specifications for Sturd–I–Floor panels.

**TABLE 21.22–E**

**MINIMUM THICKNESS OF FLOOR BOARDS**

Joist Spacing (inches)	Minimum Net Thickness (inches)	
	Perpendicular to Joist	Diagonal to Joist
24	1 1/16	3/4
16	5/8	5/8

**History:** Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) and cr. (1m), Register, February, 1985, No. 350, eff. 3–1–85; renun. (8) (c) and (d) to be (8) (d) and (e) and am. (8) (d), renun. Table 21.22–A and D to be Table 21.22 A1 and E, cr. (8) (c), Table 21.22 A2, r. and recr. Tables 21.22 B and C, Register, January, 1989, No. 397, eff. 2–1–89; am. (2), (4), (5), (6) and (9), r. and recr. Table 21.22–A2, Register, March, 1992, No. 435, eff. 4–1–92; am. (5) (b) and cr. (5) (c), Table 21.22–A1, r. Table 21.22–A, Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (9), Register, January, 1999, No. 517, eff. 2–1–99; r. and recr. (1m), (4), and (5) (b), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (5) (b) 1., r. and recr. (6) Register May 2003 No. 569, eff. 8–1–03.

**Comm 21.225 Decks.** Decks attached to dwellings and detached decks which serve an exit shall comply with the applicable provisions of this chapter, including but not limited to:

- (1) Excavation requirements of s. Comm 21.14;
- (2) Footing requirements of s. Comm 21.15 (1) (f);
- (3) Frost penetration requirements of s. Comm 21.16;
- (4) Load requirements of s. Comm 21.02;
- (5) Stair, handrail and guardrail requirements of s. Comm 21.04; and
- (6) Decay protection requirements of s. Comm 21.10.

**History:** Cr. Register, March, 1992, No. 435, eff. 4–1–92.

**Subchapter VII — Walls**

**Comm 21.23 Wall design.** (1) LIVE AND DEAD LOADS. All walls shall support all superimposed vertical dead loads and live loads from floors and roofs.

(2) **HORIZONTAL WIND LOAD.** Walls shall be designed to withstand a horizontal wind pressure of at least 20 pounds per square foot applied to the vertical projection of that portion of the dwelling above grade. No wind load reduction shall be permitted for the shielding effect of other buildings.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80.

**Comm 21.24 Exterior covering.** (1) **GENERAL.** The exterior walls shall be covered with a permanent weather resistant finish.

(2) **DURING CONSTRUCTION.** During construction, wall cavity insulation may not be installed until a water-resistant exterior covering is in place over the wall cavity.

**Note:** An example of acceptable water-resistant covering is foam sheathing with taped joints and the permanent doors and windows installed.

(3) **FLASHING.** (a) Corrosion-resistant flashing shall be installed in the exterior wall to prevent water from entering the wall cavity or coming in contact with the structural framing components.

(b) The flashing shall extend to the surface of the exterior wall finish and prevent water from reentering the exterior wall.

(c) Flashing shall be provided at all of the following locations:

1. At the top of all exterior door and window openings, unless using self-flashing windows that provide at least one inch of flashing around the opening, including the corners.

2. At the intersection of chimneys or other masonry construction with frame walls.

3. Under and at the ends of masonry, wood or metal copings and sills.

4. Continuously above all projecting wood trim.

5. Where porches, decks or stairs attach to a wall or floor assembly of wood frame construction.

6. At wall and roof intersections.

7. At built-in gutters.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077: cr. (3) Register May 2003 No.569, eff. 8-1-03.

**Comm 21.25 Wood frame walls.** Unless designed through structural analysis, wood frame walls shall comply with the following requirements.

(1) **STUD CONFIGURATION AND BRACING.** (a) *Studs.* Wood studs shall comply with the size and spacing requirements indicated in Table 21.25-A. Studs in the exterior walls shall be placed with the wide faces perpendicular to the plane of the wall.

(b) *Bracing.* Exterior walls shall be braced at the corners.

1. Nominal 1 inch by 4 inch continuous diagonal members set into the face of the studs at an angle between 45° and 60°; or

2. Four feet by 8 feet plywood sheathing panels not less than  $\frac{5}{16}$ -inch thick for 16-inch stud spacing and not less than  $\frac{3}{8}$  inch thick for 24-inch stud spacing; or

3. Preformed metal T-bracing not less than 22 gage (.0296 inches) thick and  $1\frac{3}{4}$  inch wide; or

4. Other approved wind bracing materials.

**Note:** See Appendix for acceptable nailing schedule.

**Note:** See s. Comm 21.10 for requirements on treating wood for decay and termite resistance.

(2) **TOP PLATES.** (a) *General.* Except as allowed under subd. 3., top plates shall be provided and configured as follows:

1. Studs at bearing walls shall be capped with double top plates.

2. End joints in double top plates shall be offset at least 2 stud spaces.

3. Double top plates shall be overlapped at the corners and at intersections of partitions.

4. The plate immediately above the stud may have a joint only when directly over the stud.

(b) *Notching and boring.* 1. When piping or ductwork is placed in an exterior wall or an interior load-bearing wall, such that at least half of the top plate is removed, the plate shall be reinforced with a steel angle at least 2 inches by 2 inches by 20 gauge thick.

**Note:** 20 gauge is approximately 0.036 inch.

2. The steel angle shall span the gap and extend at least to the midpoint of the adjacent stud spaces.

3. Other equivalent materials may be used in accordance with s. Comm 21.02.

(c) *Exceptions.* 1. A single top plate may be used in place of a double top plate provided a rafter is located directly over the studs and the plate is securely tied at the end joints, corners and intersecting walls. Joints may occur in single top plates only when directly over a stud.

2. A continuous header, consisting of two 2-inch members set on edge, may be used in lieu of a double plate if tied to the adjacent wall.

(3) **WALL OPENINGS.** Where doors or windows occur, headers shall be used to carry the load across the opening.

(a) *Header size.* The size of headers shall be determined in accordance with the spans and loading conditions listed in Tables 21.25-B, 21.25-C and 21.25-D. Headers for longer spans shall be designed by an engineering method under s. Comm 21.02.

(b) *Header support.* Headers in bearing walls shall be supported in accordance with subd. 1. or 2. or 3.

1. Headers 3 feet or less in length shall be directly supported on each end by either:

a. The single common stud and a shoulder stud; or

b. The single common stud with a framing anchor attached.

2. Headers greater than 3 feet but less than or equal to 6 feet in length shall be directly supported on each end by the single common stud and a shoulder stud.

3. Headers greater than 6 feet in length shall be directly supported on each end by the single common stud and 2 shoulder studs.

(4) **NOTCHING.** Notching and boring of columns or posts is prohibited unless designed through structural analysis. Studs shall not be cut or bored more than  $\frac{1}{3}$  the depth of the stud, unless the stud is reinforced.

(5) **PARTITIONS.** Load-bearing partitions shall be placed over beams, girders, or other load-bearing partitions. Load-bearing partitions running at right angles to the joists shall not be offset from the main girder or walls more than the depth of the joist unless the joists are designed to carry the load.

(6) **POSTS AND COLUMNS.** (a) *General.* 1. Posts and columns shall be installed to resist imposed loads.

2. Posts and columns shall bear directly over the middle  $\frac{1}{3}$  of a footing.

3. Posts and columns shall be restrained at the top and bottom to resist displacement.

4. Posts and columns that use a height adjustment mechanism shall have the mechanism imbedded in concrete or permanently disabled after installation.

(b) *Bearing surface.* Posts and columns shall have a steel bearing plate affixed to one or both ends to distribute any applied loads and to prevent fiber crushing of any structural member being supported.

(c) *Steel posts or columns.* Steel posts or columns shall be sized according to one of the following methods:

1. Manufactured columns shall follow the manufacturer's testing and listing.

2. Columns made solely of steel pipe stock shall follow Table 21.25-E.



3. Columns made of steel stock, not meeting the requirements of subd. 1. or 2., shall follow a nationally accepted design specification or the size shall be determined through structural analysis or load testing.

(d) *Wood posts or columns.* Wood posts or columns shall be sized according to Table 21.25–F or the size shall be determined through structural analysis or load testing.

**TABLE 21.25–A**

**MAXIMUM UNBRACED STUD LENGTH WITH SPACING AND LOADING**

Size	Grade	Max. Height (feet)	Spacing (inches)			
			Supporting roof and ceiling only	Supporting one floor, roof and ceiling	Supporting two floors, roof and ceiling	Interior and non-load-bearing
2x3	Standard & better	8	16	N/P	N/P	24
2x4 or larger	Utility	8	24	16	12	24
2x4	Standard or better	10	24	24	12	24
2x6 or larger	No. 3 & better	10	24	24	16	24

N/P = Not permitted.

**Note:** A 3–story frame house with walls constructed of 2 x 4 standard grade studs would require a 12–inch stud spacing on the lowest level, a 24–inch stud spacing on the intermediate level, and a 24–inch stud spacing on the upper level.

**TABLE 21.25–B**

**ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ROOF/CEILING ASSEMBLIES\***

House Width (feet)	Header Members									
	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1	
24	2.5	2.5	4	4	5	5	7	6	9	8
26	2.5	2	4	3	5	5	7	6	8	7
28	2.5	2	4	3	5	4	6	6	8	7
30	2.5	2	4	3	5	4	6	6	8	7
32	2	2	3	3	5	4	6	5	7	7

**TABLE 21.25–C**

**ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR\***

House Width (feet)	Header Members				
	Two 2 x 4s	Two 2 x 6s	Two 2 x 8s	Two 2 x 10s	Two 2 x 12s
24	2.5	4	5	6	8
26	2.5	3	5	6	8
28	2	3	5	6	7
30	2	3	4	6	7
32	2	3	4	5	7

**TABLE 21.25–D**

**ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR AND ROOF/CEILING ASSEMBLY\***

House Width (feet)	Header Members									
	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1	
24	1.5	1.5	3	2.5	4	3	5	4	6	5
26	1.5	1.5	2.5	2.5	3	3	4	4	5	5
28	1.5	1.5	2.5	2.5	3	3	4	4	5	5
30	1.5	1.5	2.5	2.5	3	3	4	4	5	5
32	1.5	1.5	2.5	2	3	3	4	4	5	5

\*These tables are based on wood with a fiber bending stress of 1,000 psi. For other species with different fiber bending stresses, multiply the span by the square root of the ratio of the actual bending stress to 1,000 psi. Example: From Table 21.25–B, the allowable roof/ceiling span for a 28–foot wide house in zone 2, using two 2 x 8 header members with a 1400 psi bending stress, is 5 feet  $\times \sqrt{1400/1000} = 5.9$  feet.

TABLE 21.25-E

COLUMNS MADE OF STEEL PIPE STOCK <sup>1,2</sup>				
Column Diameter (inches)	Wall Thickness (inches)	Weight/ft (pounds)	Height (feet)	Allowable Load (pounds)
3	0.216	7.58	8	34,000
			10	28,000
			12	22,000
3.5	0.226	9.11	8	44,000
			10	38,000
			12	32,000
4	0.237	10.79	8	54,000
			10	49,000
			12	43,000
5	0.258	14.62	8	78,000
			10	73,000
			12	68,000
6	0.280	18.97	8	106,000
			10	101,000
			12	95,000

<sup>1</sup>This Table is based on a yield strength or Fy of 36,000 psi.

<sup>2</sup>This table is for columns made solely of steel pipe stock. The addition of any adjustment mechanism or other feature will alter the load-carrying capacity of the column.

TABLE 21.25-F

WOOD COLUMNS

Wood Nominal Size (inches)	Cross Section Area (inches)	Height (feet)	Allowable Load (pounds)
4 x 4	12.25	8	4,900
		10	3,100
		12	2,150
4 x 6	19.25	8	7,700
		10	4,900
		12	3,400
6 x 6	30.25	8	30,000
		10	18,900
		12	13,300

**Note:** This Table is based on a modulus of elasticity or E of 1,000,000 psi and a fiber bending strength or F<sub>b</sub> of 1,000 psi.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; cr. (1) (d) and am. (3) (b), Register, February, 1985, No. 350, eff. 3-1-85; r. and recr. (3) (b), am. Table 21.25 B and E, Register, January, 1989, No. 397, eff. 2-1-89; am. (3) (a) and (6), Register, March, 1992, No. 435, eff. 4-1-92; r. and recr. (1) (c), am. Table 21.25-D, cr. Table 21.25-F, Register, November, 1995, No. 479, eff. 12-1-95; am. Table 21.25-A, Register, January, 1999, No. 517, eff. 2-1-99; r. (1) (b) and (c), renum. (1) (d) to be (b), r. and recr. (2), (6) and Tables 21.25-E and F, and am. (3) (b) 3., Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077: r. (3) (c) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.26 Masonry walls.** Masonry walls shall be constructed in accordance with the requirements of this section.

(1) **COLD WEATHER WORK.** In cold weather, provisions shall be taken to prevent masonry from being damaged by freezing.

**Note:** It will be the practice of the department to accept performance with "Recommended Practices for Cold Weather Masonry Construction," available from International Masonry Institute, 823 15th Street NW, Washington, D.C. 20005.

(2) **MASONRY UNITS.** (a) *Unused concrete units.* Previously unused concrete masonry units shall conform to the ASTM C 90 standard.

(b) *Unused clay or shale units.* Previously unused clay or shale masonry units shall conform to the appropriate ASTM standard: C 62; C 216; or C 652. Units which will be exposed to weathering or frost action shall be Grade SW as specified in these standards.

(c) *Used masonry units.* All previously used masonry units shall be free from physical defects which interfere with the installation or impair the structural properties of the unit.

(3) **TYPES OF MORTAR.** The type of masonry mortar to be used for various kinds of masonry work shall be determined from Table 21.26-A. The mortar shall conform to the property requirements of Table 21.26-B1 and to the requirements of ASTM C-270 or shall be mixed in accordance with the proportions specified in Table 21.26-B.

(a) *Surface bond mortars.* Surface bond mortars for masonry walls shall be mixed in accordance with the proportions specified on the bag.

(4) **MORTAR COMPONENTS.** Mortar components shall comply with the following requirements:

(a) *Water.* Water shall be clean and free of deleterious amounts of acids, alkalies, or organic materials.

(b) *Admixtures or mortar colors.* Admixtures or mortar colors shall not be added to the mortar unless the resulting mortar conforms to the requirements of the mortar specifications. Only calcium chloride may be used as an accelerant and shall be limited to 2% by weight of the cement used. Calcium chloride may not be used for any other purpose. Only mineral oxide may be used as mortar color and shall not exceed 10% by weight of the cement used.

(c) *Mixing.* Mortar shall be mixed for at least 3 minutes after all ingredients have been added with the maximum amount of water to produce a workable consistency. Mortars that have stiffened due to water evaporation shall be retempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2<sup>1</sup>/<sub>2</sub> hours after mixing.

**Note:** To ensure proper mortar mixing, machine mixing is recommended.

TABLE 21.26-A

TYPES OF MORTAR FOR VARIOUS KINDS OF MASONRY

Kind of Masonry	Types of Mortar
<b>Foundations:</b>	
Footings	M, S
Walls of solid units	M, S, N
Walls of hollow units	M, S
Hollow walls	M, S
<b>Masonry other than foundation masonry:</b>	
Piers of solid masonry	M, S, N
Piers of hollow units	M, S
Walls of solid masonry	M, S, N, O
Walls of solid masonry not less than 12 in. thick or more than 35 ft. in height, supported laterally at intervals not exceeding 12 times the wall thickness	M, S, N, O
Walls of hollow units; load-bearing or exterior, and hollow walls 12 in. or more in thickness	M, S, N
Hollow walls, less than 12 in. thick	M, S, N
Linings of existing masonry, either above or below grade	M, S
Masonry other than above	M, S, N

TABLE 21.26-B

MORTAR SPECIFICATIONS BY PROPORTION<sup>1</sup>

Mortar Type, ASTM C 270	Parts by Volume			
	Portland Cement	Masonry Cement	Hydrated Lime	Sand, Damp Loose Volume
M	1	—	1/4	Not less than 2 <sup>1</sup> / <sub>4</sub>
	1	1 (Type II)	—	
S	1	—	1/4 to 1/2	and not more than 3 times the sum of
	1/2	1 (Type II)	—	
N <sup>2</sup>	1	—	1/2 to 1 <sup>1</sup> / <sub>4</sub>	the volumes of the cements and lime.
	—	1 (Type II)	—	

<sup>1</sup>All cements are one cubic foot per sack; lime equals 1<sup>1</sup>/<sub>4</sub> cubic foot per sack.

<sup>2</sup>Limited to walls with a maximum depth of 5 feet below grade.

**TABLE 21.26–B1**  
**MORTAR PROPERTY REQUIREMENTS**

Mortar Type	Compressive Strength Min. (psi)	Water Retention Min. (%)	Air Content Max. (%)
M	2,500	75	18
S	1,800	75	18
N	750	75	18

(d) *Cementitious material.* Cementitious material shall conform to the standards approved by the department.

**Note:** The department will accept cementitious material conforming to the following standards: ASTM C91, Masonry Cement; ASTM C150, Portland Cement; ASTM C595, Portland Blast–Furnace Slag Cement; ASTM C207, Hydrated Lime for Masonry Purposes; and ASTM C5, Quick Lime for Structural Purposes.

(e) *Aggregates.* Aggregates for use in masonry mortar shall consist of natural sand or manufactured sand and shall be graded.

**Note:** The department will accept aggregates in accordance with ASTM C144.

(5) **CAVITY WALL.** (a) *Corbeling.* Cavity wall construction may be supported on an 8–inch foundation wall provided the 8–inch wall is corbelled with solid masonry to the width of the cavity wall. Individual corbels shall not exceed 2 inches nor more than one–third the height of each corbelled unit.

(b) *Projections.* The projection of a wall beyond the edge of a supporting member other than masonry, such as a shelf angle or edge of a beam, shall not exceed 1 1/4 inches, unless at least 2/3 the mass of the wythe of masonry involved is located directly over the load–carrying member.

(c) *Flashing.* In exterior hollow walls exposed to the weather, flashing shall be installed at the bottom of the cavity formed by openings such as lintels over doors and windows and the back–sides of chimneys so as to drain any water outward. Open vertical joints or weep holes of 3/8–inch minimum diameter shall be provided in the facing directly above the flashing at a horizontal spacing not exceeding 3 feet.

(6) **OPENINGS AND LINTELS.** (a) *Openings.* The masonry above openings shall be supported. The bearing length of structural elements which support the masonry above the opening shall be not less than 4 inches.

(b) *Lintels.* Unless designed through structural analysis, lintels shall be provided using either steel angles or reinforcing bars in accordance with Table 21.26–C.

**TABLE 21.26–C**  
**ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER**

Size of Steel Angle <sup>1,3</sup>	No Story Above	One Story Above	Two Stories Above	No. of 1/2" or Equivalent Reinforcing Bars <sup>2</sup>
L 3 x 3 x 1/4	6'–0"	3'–6"	3'–0"	1
L 4 x 3 x 1/4	8'–0"	5'–0"	3'–0"	1
L 6 x 3 1/2 x 1/4	14'–0"	8'–0"	3'–6"	2
2–L 6 x 3 1/4 x 1/4	20'–0"	11'–0"	5'–0"	4

<sup>1</sup> Long leg of the angle shall be placed in a vertical position.

<sup>2</sup> Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.

<sup>3</sup> Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.

(7) **MASONRY VENEERS.** (a) *Veneer over frame construction.*  
1. Masonry veneers may be corbelled over the foundation wall, but the corbeling shall not exceed one inch.

2. An air space shall be provided between the veneer and the sheathing.

3. Where no brick ledge is formed in the foundation wall, corrosion resistant metal or other water–resistant flashing shall extend over the top of the foundation wall from the outside face of the wall and shall extend at least 6 inches up on the sheathing. The flashing shall be installed to drain any water outward.

4. Weep holes shall be provided at the bottom masonry course at maximum intervals of 2 feet.

(b) *Veneer over masonry back–up.* Corrosion–resistant metal or other water–resistant base flashing shall be provided at the bottom of the veneer and shall extend over the top of the foundation and up at least 6 inches and be embedded in the back–up course. The flashing shall be installed to drain any water outward. Weep holes shall be provided at maximum intervals of 3 feet.

(8) **VENEER ANCHORAGE.** All veneers, supports and attachments shall be mechanically or adhesively anchored.

(a) *Mechanical anchorage.* All anchors shall be corrosion–resistant.

1. Conventional size veneer (one square foot or less) shall be securely attached to its backing by anchors the equivalent of No. 22 U.S. gauge corrugated sheet steel 7/8–inch wide with at least one such tie located in every 2 square feet of wall. Ties shall be embedded 2 inches in a masonry joint and nailed to the framing with an 8d nail.

2. Large size veneer (greater than one square foot) shall be securely attached with anchors the equivalent of not less than 1/4–inch diameter bolts in accordance with either of the following:

a. Each unit individually anchored to the supporting framework with at least 3 anchors.

b. Individual units doweled to each other at all horizontal joints and anchored to the backing at all horizontal and vertical joints so that one anchor is provided for every 6 square feet of wall surface.

(b) *Adhesive anchorage.* Veneer may be cemented to a masonry or concrete wall or to exterior portland cement plaster in high rib galvanized metal lath with an adhesive, provided that the bond is sufficient to withstand a shearing stress of 50 psi after curing for 28 days.

(9) **BEARING.** (a) *Concentrated loads.* Beams, girders, trusses, joists and other members producing concentrated loads shall bear a minimum of 3 inches on one of the following:

1. ‘Concrete beam.’ The equivalent of a nominally reinforced 2,500 psi concrete beam 8 inches in height.

2. ‘Solid masonry.’ At least 8 inches in height of masonry composed of solid masonry units with all voids and joints completely filled with mortar.

3. ‘Metal plate.’ A metal plate of sufficient thickness and size to distribute the load to masonry units. For piers and columns, the bearing plate shall not exceed 60% of the cross–sectional area of the pier or column and the resultant reaction of all vertical and horizontal loads shall fall within the middle third of the member.

4. ‘Bond beam.’ The bond beam shall be the equivalent of not less than an 8–inch lintel (bond beam) block with 2 No. 4 bars embedded in high strength mortar fill or equivalent. The loads shall bear on the fill.

(b) *Continuous loads.* Joists, trusses and beams other than wood, spaced 4 feet or less on center and 40 feet or less in length, slabs or other members causing continuous loads shall be transmitted to masonry with a minimum bearing of 3 inches upon solid masonry at least 2 1/2 inches in height, or as indicated for concentrated loads.

(c) *Stack bond walls.* Concentrated loads shall be distributed into masonry laid in stack bond by a concrete beam or bond beam [as defined in par. (a)]. For masonry of solid units, 2 additional rows of a continuous tie assembly may be used instead of a concrete beam or bond beam.

(d) *Support of wood floor members.* Where a wood structural member is buried in masonry for support, it shall be firecut or a self-releasing device shall be used. Where the end of a wood structural member is built into an exterior wall, a 1/2-inch air space shall be provided at the sides, top and end of such member.

(10) **BONDING.** Unless designed through structural analysis, all masonry walls shall be bonded as follows:

(a) *Single-wythe walls.* Masonry units in single-wythe walls shall be lapped at least 2 inches or one-third the height of the masonry unit, whichever is greater, or through the use of continuous tie assemblies spaced at 16-inch vertical intervals.

(b) *Multi-wythe walls.* Adjacent wythes shall be bonded with continuous tie assemblies spaced at vertical intervals not exceeding 16 inches; or individual ties of at least 3/16-inch diameter for each 4 1/2 square feet of wall area, spaced at a maximum vertical distance of 18 inches and a maximum horizontal distance of 36 inches; or bonded with a full course of masonry headers every seventh course. The clear distance between bond courses shall not exceed 16 inches for solid masonry units and 24 inches for hollow masonry units. Hollow walls shall not be bonded with headers.

(11) **BOLTS AND ANCHORS.** The allowable shear on steel bolts and anchors shall not exceed the values given in Table 21.26.

**TABLE 21.26**

**ALLOWABLE SHEAR ON BOLTS AND ANCHORS**

Bolt or Anchor Diameter (inches)	Embedment <sup>1</sup> (inches)	Allowable Shear (pounds)
1/4	4	270
3/8	4	410
1/2	4	550
5/8	4	750
3/4	5	1100
7/8	6	1500
1	7	1850
1 1/8	8	2250

<sup>1</sup>Bolts and anchors shall be solidly embedded in mortar or grout.

(12) **JOINTS.** (a) The maximum thickness of a mortar joint shall be 1/2 inch.

(b) Except for head joints used for weepholes and ventilation, solid masonry units shall be laid to achieve full head and bed joints.

(c) Hollow masonry units shall be laid with full head joints and full bed joints under the full bearing areas of the face shells and under webs where the adjacent cells are to be filled with grout.

(13) **CLEANING.** Chemical cleaning agents shall be prevented from harming the metal reinforcement of structural components and shall not be of a strength which will adversely affect the mortar.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. (3) and cr. Table 21.26-B1 Register, February, 1985, No. 350, eff. 3-1-85; am. (9) (b), Register, January, 1989, No. 397, eff. 2-1-89; am. (6) (b), Register, March, 1992, No. 435, eff. 4-1-92; r. and recr. (2), am. (5) (c), (7) (a) 3., 4., (b), r. (14), Register, November, 1995, No. 479, eff. 12-1-95; CR 02-077: am. (7) (a) 4. Register May 2003 No. 569, eff. 8-1-03.

**Subchapter VIII — Roof and Ceilings**

**Comm 21.27 Roof design.** (1) **ROOF LOADS.** (a) *General.* Roof and roof/ceiling assemblies shall support all dead loads plus the minimum live loads as set forth in par. (b) and s. Comm 21.02.

(b) *Slope roof snow loads.* Snow loads specified in s. Comm 21.02 (1) (b) 2. may be reduced for roof slopes greater than 30° by multiplying the snow load by Cs. The value of Cs shall be determined by the following:  $C_s = 1 - \frac{(a-30)}{40}$  where a is the slope of the roof expressed in degrees.

(2) **UPLIFT AND SUCTION FORCES.** Roofs shall withstand a pressure of at least 20 pounds per square foot acting upward normal to the roof surface. Roof overhangs, eaves, canopies and cornices shall withstand an upward wind pressure of at least 20 pounds per square foot applied to the entire exposed area.

(a) *Anchorage.* Roofs shall be anchored to walls and columns to resist uplift.

(b) *Stress increase.* All stresses may be increased by a maximum of one third for wind forces.

(3) **WATER.** All roofs shall be designed and constructed to assure drainage of water.

(a) *Roofing.* 1. 'General.' a. Underlayment consisting of number 15 asphalt-impregnated felt paper or equivalent or other type I material that shows no water transmission when tested in accordance with ASTM D 226 or ASTM D 4869 shall be provided under shingles.

**Note:** Underlayment materials meeting the requirements of ASTM D 1970 meet the performance requirements of this section.

b. Fasteners shall be corrosion resistant.

**Note 1:** See s. Comm 20.07 (62) for definitions of shingle terms.

**Note 2:** *The Residential Asphalt Roofing Manual* can be purchased from the Asphalt Roofing Manufacturers Association at 6000 Executive Boulevard, Suite 201, Rockville, Maryland 20852-3803. This manual contains extensive information on shingles from manufacture through installation, inspection and maintenance. It includes a recommendation that properly driven and applied nails are the preferred fastening system for asphalt shingles.

**Note 3:** Section Comm 20.04 (2) requires compliance with all parts of this code, including these roofing provisions, for an alteration to any dwelling that is regulated under this code.

2. Asphalt shingles. a. Organic asphalt shingles shall conform to ASTM D 225 and the Class C requirements of ASTM E 108, and shall pass the wind resistance test of ASTM D 3161.

b. Fiberglass asphalt shingles shall conform to ASTM D 3462 except that laminated shingles shall have a tear strength of at least 1450 grams in each ply.

c. Shingles that have a self-sealing adhesive strip shall include a sealant which has an average bond strength of at least 1.5 pounds per 3.75 inches of shingle width, at 32° F.

**Note:** The department will accept the results of testing conducted in accordance with an approved test method for verifying compliance with the sealant uplift resistance required in this subparagraph. Information on the applicable test method may be obtained from the department.

d. Each shingle package shall be labeled by the manufacturer to indicate conformance to the applicable ASTM standard for each type of shingle or the exception in subd. 2. b.

e. Shingles shall be installed in accordance with the manufacturer's recommendations. Shingles shall have at least 4 fasteners per strip shingle or 2 fasteners per interlocking shingle. Shingle head lap shall be at least 2 inches.

(b) *Ice dam protection.* 1. Shingled or shake roofs that extend over a heated area of a dwelling or attached garage and that have a slope of 4:12 or less shall be provided with ice dam protection in the form of sheet metal or a product labeled as meeting the requirements of ASTM D 1970.

2. The ice dam protection shall extend at least 30 inches up the roof slope from the roof edge and at least 12 inches up the roof slope beyond the inner face of the exterior wall.

(4) **FLASHING.** Flashings shall be installed at the junction of chimneys and roofs, in all valleys, and around all roof openings.

(a) *Valley flashing.* 1. 'Open valleys.' Open valleys shall be flashed with at least No. 28 gauge galvanized, corrosion-resistant sheet metal, 16 inches wide, or a layer of at least 50-pound roll roofing, 16 inches wide, placed over a layer of 15-pound roofing underlayment. Flashing sections shall be overlapped by at least 4 inches.

2. 'Closed valleys.' Where shingles are laced or woven over the valley, the valley shall be flashed with at least one layer of 50-pound roofing, at least 20 inches wide, over the layer of 15-pound roofing underlayment.



(b) *Chimney flashing*. 1. Chimney crickets shall be installed where the upper side of a chimney is more than 30 inches wide on a sloping roof. The intersection of the cricket and the chimney shall be flashed and counter-flashed to a height of at least 4 inches.

2. Chimneys not exceeding 30 inches wide shall be flashed and counter-flashed to a height of at least 6 inches.

3. Chimney sides shall be flashed to a height of at least 4 inches.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am (3) (a), Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. (1), am. (3) (a), Register, March, 1992, No. 435, eff. 4-1-92; r. and recr. (3) (a), Register, November, 1995, No. 479, eff. 12-1-95; r. and recr. (3) (a) 1. and 2. c., Register, January, 1999, No. 517, eff. 2-1-99; am. (3) (a) 1. a., Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077: r. and recr. (3) (b) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.28 Roof and ceiling wood framing.** Unless designed through structural analysis, wood rafters and ceiling joists, and components, shall comply with the requirements of s. Comm 21.02 (3).

(1) **ROOF RAFTERS.** (a) *Ridge boards*. 1. Where rafters meet to form a ridge, the rafters shall be attached to a ridge board.

2. The ridge board shall have a depth at least equal to the length of the cut end of the rafter abutting it.

3. Where all rafters are placed directly opposite each other or are offset at the ridge board by less than the thickness of the rafter, the ridge board shall have a nominal thickness of at least 1 inch.

4. Where one or more rafters are offset at the ridge board by more than the thickness of the rafter, the ridge board shall have a nominal thickness of at least 2 inches.

(b) *Bearing*. The required bearing for wood rafters shall be in accordance with the National Design Specification for Wood Construction published by American Forest & Paper Association. In no case shall the bearing be less than 1½ inches on wood or metal or less than 3 inches on masonry or concrete.

(2) **ANCHORAGE.** Roofs shall be anchored to resist horizontal thrust and uplift. Provisions shall be taken to absorb the horizontal thrust produced by the sloping roof, rafters or beams through collar ties installed in the upper third of the roof rafters on every third pair of rafters; or through the use of cross ties connecting beams; or through the use of metal straps or metal plates located at the ridge which tie the roof beams together. Rafters shall be notched to fit the exterior wall plate and fastened to the wall.

(2m) **CATHEDRAL CEILINGS.** In cathedral ceilings, the upper end of the rafters shall be supported by a ridge beam or bearing wall, or thrust restraint shall be provided per s. Comm 21.02.

(3) **CEILING JOISTS.** Ceiling joists shall be nailed to exterior walls and to the ends of rafters. Where joining over interior partitions, they shall be nailed to the plate or to each other. Where ceiling joists are placed at right angles to the rafters, as in flat or hip roofs, the lookout joist or ties shall be fastened to the parallel ceiling joists or rafters.

(4) **VALLEY AND HIP RAFTERS; LADDERS.** (a) *Valley rafters*. Where no bearing is provided under valley rafters at the intersection of 2 roof areas, the valley rafters shall be doubled in thickness and shall be at least 2 inches deeper than the required common rafter to permit full bearing at the beveled end. Where ridges are provided at different elevations, care should be taken to provide vertical support for the interior end of the lower ridge board.

(b) *Hip rafters*. Where no bearing is provided under hip rafters, the hip rafters shall be of the same thickness as common rafters and shall be at least 2 inches deeper to permit full contact with the jack rafter.

(c) *Ladders*. Overhangs at gable end walls of more than 12 inches shall be provided with ladders (rafters which extend over the wall) which extend into the structure a distance no less than the length of the overhang. The ladders shall be fastened at the wall. The interior end of each ladder shall be attached to a rafter or truss with a hanger.

(5) **ROOF TRUSSES.** Metal plate connected wood roof trusses shall be designed in accordance with the Design Specifications for Metal Plate Connected Wood Trusses and the National Design Specification for Wood Construction. Truss members shall not be cut, bored or notched.

(6) **NOTCHING AND BORING.** (a) *General*. 1. Notching and boring of beams or girders is prohibited unless determined through structural analysis.

2. Notching and boring of ceiling joists and rafters shall comply with pars. (b) and (c).

(b) *Notching*. 1. Notches located in the top or bottom of ceiling joists and rafters are prohibited from all of the following:

a. Having a depth exceeding 1/6 the depth of the member.

b. Having a length exceeding 1/3 the depth of the member.

c. Being located in the middle 1/3 of the span of the member.

2. Where ceiling joists or rafters are notched at the ends, the notch may not exceed 1/4 the depth of the member.

3. Bird mouth cuts may not exceed 1/3 the depth of the rafter unless the seat cut bears fully on the wall plate.

(c) *Boring*. 1. Holes bored within 2 inches of the top or bottom of ceiling joists or rafters may not be located in the middle 1/3 of the span of the member.

2. The diameter of a hole may not exceed 1/3 the depth of the member.

3. A hole may not be bored within 2 inches of a notch or another hole.

4. The distance between adjacent holes may not be less than the diameter of the larger hole.

(d) *Engineered wood products*. Notching or boring of engineered wood products shall be done in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing. Trusses shall be anchored in accordance with standards and recommendations published by the Truss Plate Institute.

(7) **ROOF SHEATHING, BOARDS AND PLANKING.** (a) *Plywood sheathing*. Plywood sheathing and similar sheathing materials which are rated by the American Plywood Association shall be grade marked and stamped and limited to the allowable loads and spans indicated in Table 21.28-A.

(b) *Roof boards*. Roof boards shall comply with the minimum thicknesses shown in Table 21.28-B.

(c) *Roof planks*. Roof planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness. Planks shall terminate over beams unless the joints are end matched. The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be nailed or fastened to each beam.

**TABLE 21.28-A**  
**ALLOWABLE LOADS AND SPANS FOR PLYWOOD ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS**  
**AND FACE GRAIN PERPENDICULAR TO SUPPORTS<sup>1,2,3</sup>**

Panel Span Rating	Plywood Thickness (inches)	Maximum Span (inches)		Load (in pounds per square foot)	
		Edges Blocked	Edges Unblocked	Total Load	Live <sup>4</sup> Load
12/0	5/16	12	12	40	30
16/0	5/16, 3/8	16	16	40	30
20/0	5/16, 3/8	20	20	40	30
24/0	3/8	24	20	40	30
24/16	7/16, 1/2	24	24	50	40
32/16	15/32, 1/2, 5/8	32	28	40	30
40/20	19/32, 5/8, 3/4, 7/8	40	32	40	30
48/24	23/32, 3/4, 7/8	48	36	45	35

<sup>1</sup> Spans shall be limited to values shown, based on possible effect of concentrated loads.

<sup>2</sup> Underlayment, C-C Plugged, sanded exterior type: allowable uniform load based on deflection of L/360 span for spans 24 inches or less is 125 psf; and for spans 48 inches, 65 psf.

<sup>3</sup> Plywood sheathing may be installed with face grain parallel to supports in accordance with the "APA Design/Construction Guide", American Plywood Association, P.O. Box 11700, Tacoma, WA 98411.

<sup>4</sup> Assumes 10 psf dead load.

**TABLE 21.28-B**  
**MINIMUM THICKNESS OF ROOF BOARDS**

Rafter Spacing (inches)	Minimum Net Thickness (Inches)	
	Solid Sheathing	Spaced Sheathing
24	5/8	3/4

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. (7) (a), r. and recr. Table 21.28-A, Register, January, 1989, No. 397, eff. 2-1-89; am. (1), (5) and (6), cr. (2m) and (6) (a) 3., r. and recr. (4) (c), Register, March, 1992, No. 435, eff. 4-1-92; cr. (6) (c), Register, November, 1995, No. 479, eff. 12-1-95; CR 02-077: r. and recr. (1) (a), renum. (6) (intro) to (c) to be (6) (a) to (d) and am. (6) (a) to (c) Register May 2003 No. 569, eff. 8-1-03.

**Subchapter IX — Fireplace Requirements**

**Comm 21.29 Masonry fireplaces.** Masonry fireplaces shall be constructed of masonry, stone or concrete. Masonry fireplaces shall be supported on foundations of concrete or masonry. Structural walls shall be at least 8 inches thick. Masonry fireplaces shall conform to the following requirements:

(1) **FLUE SIZE.** The fireplace flue size shall be based on the type of flue and the fireplace opening indicated in Table 21.29.

**TABLE 21.29**  
**MINIMUM FLUE SIZE FOR MASONRY FIREPLACES**

Type of Flue	Minimum Cross-Sectional Area
Round	1/12 of fireplace opening but not less than 75 square inches.
Square or rectangular	1/10 of fireplace opening but not less than 75 square inches.

(2) **TERMINATION OF CHIMNEY.** Masonry fireplace chimneys shall extend at least 3 feet above the highest point where the chimney passes through the roof and at least 2 feet higher than any portion of the dwelling within 10 feet of the chimney.

(3) **FIREBOX MATERIALS.** The firebox shall be of the preformed metal type, at least 1/4-inch thick, or listed by a nationally recognized laboratory; or shall be lined with firebrick, at least 2 inches thick and laid in thin joints of refractory cement. The back and sidewalls of the firebox, including the lining, shall be at least 8 inches nominally thick masonry, at least 4 inches of which shall be solid.

(4) **LINTEL.** Masonry over the fireplace opening shall be supported by a lintel of steel or masonry.

(5) **DUCTS.** Warm-air circulating ducts shall be constructed of masonry or metal.

(5m) **RETURN AIR GRILLES.** Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or in a confined space defined under s. Comm 23.06 in which a draft diverter or draft regulator is located.

(6) **HEARTH EXTENSION.** (a) Masonry fireplaces shall have a hearth extension made of noncombustible material.

(b) The structural support for the hearth and hearth extension shall be a minimum of 4 inches of reinforced concrete.

(c) There shall be no structural framing material within 1 inch of the hearth or hearth extension in any direction. Any wooden forms or supports used during construction shall be removed.

(d) The minimum dimensions of the hearth extension shall be in accordance with Table 21.29-1.

**TABLE 21.29-1**  
**HEARTH EXTENSION DIMENSIONS**

Fireplace Opening (Sq. Ft.)	Extension from Fireplace Opening (inches)	
	Side	Front
Less than 6	8	16
6 or Greater	12	20

(7) **DAMPERS.** Dampers shall be made of cast iron or at least No. 12 gauge sheet metal. The area of the damper opening shall be at least 90% of the required flue area when in the open position.

(8) **HOODS.** Metal hoods, used in lieu of a masonry smoke chamber, shall be constructed of at least No. 19 gauge corrosion-resistant metal with all seams and connections of smokeproof construction. The hood shall be sloped at an angle of 45° or less from the vertical and shall extend horizontally at least 6 inches beyond the firebox limits. Metal hoods shall be kept a minimum of 18 inches from the combustible materials unless approved for reduced clearances.

**Note:** The department will accept dampers and hoods listed by nationally recognized laboratories.

(9) **FLUE LINERS.** (a) Flue liners shall be installed in accordance with s. Comm 21.30 (7) and this section.

(b) Flue liners shall start at the top of the fireplace throat and extend to a point at least 4 inches above the top of the chimney cap.

(c) Firebrick may be used in the throat of the fireplace as an inlet to the flue liner.

(10) **CLEANOUT OPENINGS.** Fireplaces with ash dumps shall be provided with cleanout openings at the base. Doors and frames of the opening shall be made of ferrous materials.

(11) **MANTEL SHELVES AND COMBUSTIBLE TRIM.** Woodwork or other combustible materials shall not be placed within 6 inches of

the fireplace opening. Combustible materials located within 12 inches of the fireplace opening shall not project perpendicularly more than  $1/8$ -inch for each inch distance from the opening.

(12) **FRAMING AROUND FIREPLACES.** Combustible materials located near fireplaces shall be installed in accordance with s. Comm 21.30 (9).

(13) **CORBELING.** Unless designed through structural analysis, masonry chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry chimney be corbeled from a wall less than 12 inches in nominal thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one-inch projection for each brick course.

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. Register, February, 1985, No. 350, eff. 3-1-85; am. (6) and Table 21.29-1, Register, January, 1989, No. 397, eff. 2-1-89; am. (intro.) and (12), cr. (5m), r. and recr. (6), Register, March, 1992, No. 435, eff. 4-1-92; r. (12) and renum. (13) and (14) to be (12) and (13), Register, January, 1999, No. 517, eff. 2-1-99; r. and recr. (6) and (9), Register, March, 2001, No. 543, eff. 4-1-01.

**Comm 21.30 Masonry chimneys.** Masonry chimneys shall conform to the following provisions:

(1) **MATERIALS.** No masonry chimney shall rest upon wood. The foundation shall be designed and built in conformity with the requirements for foundations. Masonry chimney walls shall be at least 4 inches in nominal thickness. Hollow cored masonry units may be used to meet the 4 inch nominal thickness requirement.

(2) **FLUE SIZE.** Chimney flues for appliances shall be at least equal in area to that of the area of the connector from the appliance.

(3) **MULTIPLE FLUE SEPARATION.** When more than one flue is contained in the same chimney, a masonry separation of at least 4 inches nominal in thickness shall be provided between the individual flues. The joints of adjacent flue linings shall be staggered by at least 7 inches.

(4) **CORBELING.** Unless designed through structural analysis, masonry chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry chimney be corbeled from a wall less than 12 inches in nominal thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one-inch projection for each brick course.

(5) **INLETS.** Inlets to masonry chimneys shall enter the side and be provided with thimbles. Thimbles shall be at least No. 24 manufacturer's standard gauge (0.024 inch) or  $5/8$ -inch thick, refractory material. Each chimney shall have an inlet installed at the time of construction.

(6) **CLEAN-OUT OPENING.** Every masonry chimney shall be provided with a clean-out opening at the base. Such openings shall be equipped with metal doors and frames arranged to remain closed when not in use. Clean-out openings shall be located below the lowest inlet to the flue.

(7) **FLUE LINERS.** (a) Masonry chimneys shall be lined with a material that will resist corrosion, softening and cracking at temperatures up to 1800° F, such as vitrified clay sewer pipe or minimum  $5/8$ -inch thick fireclay lining material.

(b) All flue liners shall be laid in a full bed of refractory mortar or refractory cement.

(c) Variations in inside and outside dimensions shall not exceed  $1/4$  inch for clay flue liners.

(d) There shall be a minimum clearance of  $1/2$ -inch and a maximum clearance of 1-inch between the flue liner and the chimney walls.

(e) Unless serving a masonry fireplace under s. Comm 21.29, flue liners shall commence at the chimney footing.

(8) **CHIMNEY CAPS.** Chimneys shall be provided with precast or cast-in-place concrete chimney caps. Chimney caps shall have a minimum thickness of 2 inches, shall slope outwards away from the flue, and shall provide a one-inch overhang and drip edge on all sides. A slip joint shall be installed between the flue and the cap. The slip joint shall be filled with  $1/4$ -inch felt or similar mate-

rial and shall be caulked with high-temperature caulk or similar material to prevent water infiltration.

(9) **CLEARANCE TO COMBUSTIBLES.** (a) The minimum clearance between combustibles and masonry chimneys which have any portion located within the exterior wall of the dwelling shall be 2 inches. The minimum clearance between combustibles and masonry chimneys which have all parts completely outside the dwelling, exclusive of soffit or cornice areas, shall be one inch.

(b) Except as required under pars. (c) and (d), the clearance spaces shall remain completely open.

(c) The clearance spaces between chimneys and wood joists, beams, headers or other structural members shall be fireblocked at each floor level from chimney footing all the way to the roof flashing with galvanized steel, at least 26 gage thick or with non-combustible sheet material.

(d) Noncombustible material shall be used to prevent entry of debris into the clearance spaces.

**History:** Cr. Register, February, 1985, No. 350, eff. 3-1-85; am. (8), Register, March, 1992, No. 435, eff. 4-1-92; r. and recr. (8) and (9); Register, November, 1995, No. 479, eff. 12-1-95; r. and recr. (7) (a), cr. (7) (d) and (e), and am. (9) (c), Register, March, 2001, No. 543, eff. 4-1-01; CR 02-077: am. (7) (b) and (d) Register May 2003 No. 569, eff. 8-1-03.

**Comm 21.32 Factory-built fireplaces.** Factory-built fireplaces consisting of a fire chamber assembly, one or more chimney sections, a roof assembly and other parts shall be tested and listed by a nationally recognized testing laboratory.

(1) **FIREPLACE ASSEMBLY AND MAINTENANCE.** The fireplace assembly shall be erected and maintained in accordance with the conditions of the listing.

(a) All joints between the wall or decorative facing material and the fireplace unit shall be completely sealed, firestopped or draft-stopped with a noncombustible caulk or equivalent.

(b) Doors installed on factory built fireplaces shall conform with the terms of the listing and the manufacturers installation instructions for the fireplace unit.

(2) **DISTANCE FROM COMBUSTIBLES.** Portions of the manufactured chimney extending through combustible floors or roof/ceiling assemblies shall be installed in accordance with the distances listed on the chimney in order to prevent contact with combustible materials.

(3) **HEARTH EXTENSIONS.** Hearth extensions shall be provided in accordance with the manufacturer's listing. Where no hearth extension is specified in the listing, a hearth extension shall be provided in accordance with s. Comm 21.29 (6).

**History:** Cr. Register, November, 1979, No. 287, eff. 6-1-80; renum. from Ind 21.30 and r. and recr. (3), Register, February, 1985, No. 350, eff. 3-1-85; cr. (1) (a) and (b), am. (3) and Table 21.32-1, Register, January, 1989, No. 397, eff. 2-1-89; r. and recr. Register, March, 1992, No. 435, eff. 4-1-92.

## Subchapter X — Construction In Floodplains

**Comm 21.33 Construction in floodplains.** (1) **GENERAL.** Where dwelling construction is allowed by local zoning ordinances to take place in floodfringe areas of floodplains, the dwelling shall meet the requirements of this subchapter.

**Note:** The department of natural resources (DNR) and the federal emergency management agency (FEMA) also have regulations that apply to construction in floodfringe areas.

(2) **ELEVATION.** (a) *General.* Except as provided in pars. (b) and (c), all dwellings constructed within a floodfringe area shall be elevated so the lowest floor and all basement floor surfaces are located at or above the base flood elevation.

(b) *Certified floodproof basements.* Floodproof basements may have the top of the basement floor no more than 5 feet below the base flood elevation provided the basement is designed by a registered architect or engineer to be watertight and impermeable. No limitation is placed on the use or occupancy of a certified floodproof basement by the provisions of this subchapter.

(c) *Other enclosed spaces.* 1. Enclosed spaces not meeting the requirements of par. (b) are allowed at any depth below the base

flood elevation provided the spaces are used only for one or more of the following purposes:

- a. Means of egress.
- b. Entrance foyers.
- c. Stairways.
- d. Incidental storage of portable or mobile items.

2. Fully enclosed spaces used only for those purposes listed in subd. 1. shall be designed to automatically equalize the hydrostatic pressure on exterior walls by allowing the entry and exit of floodwaters. Designs for meeting this requirement shall be certified by a registered architect or engineer or shall meet all of the following requirements:

- a. There shall be at least 2 pressure relieving openings and the openings shall have a total net area of not less than one square inch for every square foot of enclosed area subject to flooding.
- b. The bottom of all openings shall be no more than 12 inches above grade.
- c. Openings may not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

**(3) CERTIFICATION OF ELEVATION.** A registered land surveyor, architect or engineer shall certify the actual elevation in relation to mean sea level of the lowest structural member required to be elevated by the provisions of this subchapter.

**(4) ANCHORAGE.** The structural systems of all dwellings shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses at the base flood elevation.

**(5) PROTECTION OF ELECTRICAL AND MECHANICAL SYSTEMS.** Electrical and mechanical equipment shall be placed above the base flood elevation or shall be designed to prevent water contact with the equipment in case of a flood up to the base flood elevation.

**(6) CONSTRUCTION MATERIALS AND METHODS.** All dwellings constructed in floodplains shall be constructed using materials and methods designed to minimize flood and water damage.

**History:** Emerg. cr. eff. 5-8-96; cr. Register, February, 1997, No. 494, eff. 3-1-97.

### Comm 21.34 Construction in coastal floodplains.

**(1) GENERAL.** All dwellings constructed in coastal floodplains shall be designed by a registered architect or engineer and shall meet the requirements of this section and s. Comm 21.33.

**(2) ELEVATION.** All dwellings constructed in a coastal floodplain shall be elevated so the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft foundations, pilings, piling caps, columns, grade beams and bracing, is located at or above the base flood elevation.

**(3) ENCLOSURES BELOW BASE FLOOD ELEVATION.** Enclosures below the base flood elevation in a coastal floodplain may not be used for human occupancy and shall be free of all obstructions, except for non-loadbearing walls and partitions. Non-loadbearing walls and partitions below base flood elevation shall be constructed to break away without causing any structural damage to the elevated portion of the dwelling or foundation system due to the effect of wind loads and water loads acting simultaneously.

**(4) FOUNDATIONS.** All dwellings located in a coastal floodplain shall be supported and anchored on pilings or columns. The piling or column shall have adequate soil penetration to resist combined water and wind loads at the base flood elevation. Piling or column design shall consider the effect of scour of soil strata. Mat or raft foundations to support columns may not be used where soil under the mat or raft is subject to scour or other erosion from wave flow conditions.

**History:** Emerg. cr. eff. 5-8-96; cr. Register, February, 1997, No. 494, eff. 3-1-97.

## Subchapter XI — Installation of Manufactured Homes

**Comm 21.40 Installation standards. (1)** (a) The installation of a manufactured home produced on or after April 1, 2007 shall comply with procedures acceptable to the department.

(b) Acceptable installation procedures shall address all of the following:

1. Soil mechanics.
2. Site preparation.
3. Structural support, stabilization and anchorage.
4. Setting.
5. Ventilation of crawl spaces.
6. Connections, plumbing, electrical, HVAC.
7. Joining of home sections.

**Note:** Acceptable installation practices can be found through the Safety and Buildings Division's website at [www.commerce.state.wi.us/SB](http://www.commerce.state.wi.us/SB) or by contacting the Safety and Buildings Division at (608) 264-9596.

**Note:** The design and construction of basements and perimeter foundations to support manufactured homes is addressed under subchapter V.

**(2)** (a) Except as provided in par. (b), the installation of a manufactured home produced before April 1, 2007 shall be installed in conformance with the requirements in effect at the time the manufactured home was produced.

(b) The installation of a manufactured home produced before April 1, 2007 to be installed on piers shall conform to at least all of the following requirements:

1. No footing may be placed upon unprepared fill material, topsoil, alluvial soil or mud. All organic matter shall be removed from the area that will be beneath any footing.

2. The soil bearing capacity shall be determined through test by a pocket penetrometer or other means of analysis. If the soil bearing capacity under each intended pier location is less than 2000 pounds per square foot, piers shall be located in accordance with the manufacturer's instructions.

3. The home site shall be graded to permit water to drain from under the home and away from the home for a minimum of 5 feet from the home.

4. Every pier shall be supported by a footing. Each footing shall be no less than a nominal 16 inches by 16 inches.

5. Each footing shall consist of one of the following:

a. One nominal 4-inch by 16-inch by 16-inch solid concrete block or 2 nominal 4-inch by 8-inch by 16-inch solid concrete blocks. If a single block pier and 2 footing blocks are used, the 2 footing blocks shall be positioned with the joint parallel to the main frame. If a double block pier and 2 footing blocks are used, the 2 footing blocks shall be positioned with the joint either parallel or perpendicular to the main frame.

b. A 16-inch by 16-inch pad constructed of acrylonitrile-butadiene-styrene (ABS) having a rated load bearing capacity of not less than 6000 pounds.

c. An 18-inch diameter hole bored to below the frost line or to unfractured bedrock and filled with poured concrete.

d. Any other materials and systems approved in advance by the department.

6. Piers shall be constructed of concrete blocks, manufactured steel stands or manufactured concrete stands. Manufactured stands shall be labeled for use as piers for manufactured homes.

7. Piers constructed of single stacked concrete blocks shall be limited to a height of 36 inches. Piers constructed of concrete blocks and exceeding 36 inches but less than 80 inches shall be constructed using double stacked blocks with each layer opposing the direction of the layer underneath it. Piers constructed of concrete blocks and exceeding 80 inches shall be constructed using double blocks laid in concrete mortar with each layer opposing the



direction of the layer underneath it and with each core filled with concrete and a 1/2-inch steel reinforcing rod.

8. All concrete blocks shall be 2-core design, construction grade blocks having nominal dimensions of at least 8 inches by 8 inches by 16 inches. All concrete blocks shall be placed with the cores open vertically. The concrete block nearest the main frame of the manufactured home shall be perpendicular to the linear direction of the frame. No concrete block may contact the main frame of the home.

9. Alternative materials may be used for pier installations provided they are approved in advance by the department.

10. Piers shall be placed under the main frame of the chassis at intervals of not more than 7 feet on-center and no more than 3 feet from the exterior side of each end wall. The 7-foot spacing requirement may be varied as permitted by footing, spacing and soil capacity tables provided by the home manufacturer.

11. Piers shall be placed under the bearing points of clear-span openings of 4 feet or more in center mating walls.

12. Piers shall be plumb and centered under the contact area at the point of support.

13. Each pier shall be capped with a solid concrete block or a solid wood block, having a nominal thickness of at least 2 inches. The cap shall be the same width and length as the top of the pier. The cap shall consist of no more than 2 pieces. Two-piece caps shall be positioned with the joint perpendicular to the main frame.

14. Where shims are utilized, wood shims shall be installed between the pier cap and the frame. Shims shall be driven from opposing sides and shall be no less than 4 inches by 8 inches.

15. Wood caps and shims shall be at least equal to No. 2 spruce pine fir having a minimum fiber bending stress rating of 1200 psi. All wood caps shall be the same species of wood, and all shims shall be the same species of wood.

16. The combination of a nominal 2-inch solid concrete block or a nominal 2-inch wood cap plus shims shall not exceed 3 1/2 inches.

17. A minimum clearance of 12 inches shall be maintained beneath the lowest point of the main frame in the area of any utility connection. A minimum clearance of 12 inches shall also be maintained under the home for at least 75% of the home. The remainder of the home may be less than 12 inches above the ground but may not touch the ground.

**History: CR 05-113: cr. Register December 2006 No. 612, eff. 4-1-07.**