

Chapter ILHR 21

CONSTRUCTION STANDARDS

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Note: Chapter Ind 21 was renumbered to be chapter ILHR 21, Register, February, 1985, No. 350, eff. 8-1-85.

Subchapter I — Scope

ILHR 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

ILHR 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.

(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.

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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.* Every dwelling shall be designed and constructed to withstand a horizontal and uplift pressure of 20 pounds per square foot acting over the surface area.

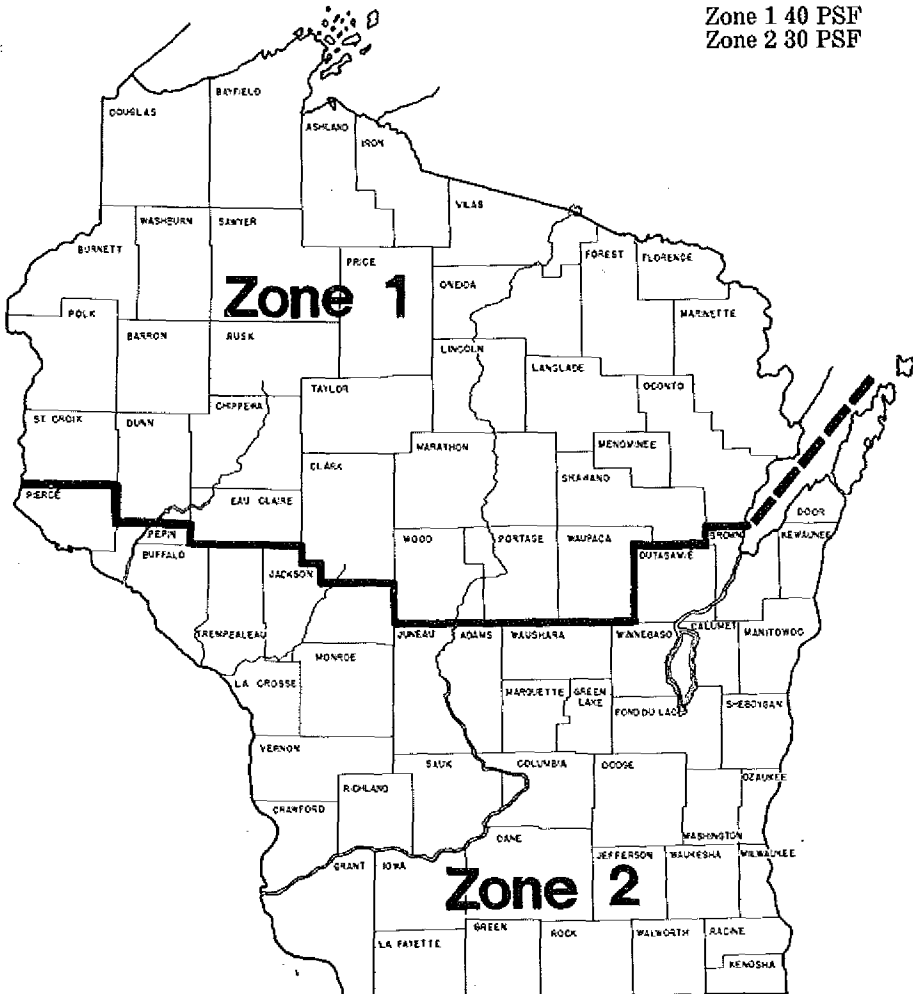
(d) *Fasteners.* All building components shall be fastened to withstand the dead load, live load and wind load. Where the effect of the dead load exceeds the wind load effect, the dwelling need not be anchored to the foundation.

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. ILHR 21.02 (3).

Figure 21.02
ZONE MAP FOR ROOF LOADS

ROOF LIVE LOADS

Zone 1 40 PSF
Zone 2 30 PSF



(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 subpar 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.

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.

Note #1: The department will accept designs and installations in conformance with the following: (1) "Plywood Design Specification" including Supplement No. 1, "Design and Fabrication of Plywood Curved Panels"; Supplement No. 2, "Design and Fabrication of Plywood-Lumber Beams"; Supplement No. 3, "Design and Fabrication of Plywood Stressed-Skin Panels"; Supplement No. 4, "Design and Fabrication of Plywood Sandwich Panels"; and Supplement No. 5, "Design and Fabrication of All-Plywood Beams"; (2) "Plywood Diaphragm Construction"; (3) Laboratory Report 121, "Plywood Folded Plate Design and Details"; and (4) Laboratory Report 93, "Load-Bearing Plywood Sandwich Panels"; (above publications available from the American Plywood Association, P.O. Box 11700, Tacoma, Washington 98411); (5) Design Guide HP-SG-71, "Structural Design Guide for Hardwood Plywood" (available from the Hardwood Plywood Manufacturers Association, 2310 S. Walter Reed Drive, Arlington, Virginia 22206); (6) U.S. Product Standard PS 1-83 for Softwood Plywood Construction and Industrial (available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402); (7) TPI-85, "Design Specification for Metal Plate Connected Wood Trusses" (available from Truss Plate Institute, Inc., 583 D'Onofrio Dr., Madison, Wisconsin 53719); (8) "Wood Structural Design Data," 1986 edition (available from National Forest Products Association, 1250 Connecticut Ave. NW, Washington, D.C. 20036).

Note #2: The department will accept plywood treated in accordance with the standards of the American Wood Preservers Association.

(b) *Structural steel.* The design, fabrication and erection of structural steel for buildings shall conform to: AISC, "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" [ILHR 20.24 (1)] and the provisions of the accompanying commentary for this specification.

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

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

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

Note: The following standards are recognized by the department as being good construction practice: (1) "Commentary on Building Code Requirements for Reinforced Concrete," ACI Report 318; (2) "Recommended Practice for Selecting Proportions for Concrete," ACI Std. 211.1; (3) "Recommended Practice for Selecting Proportions for Structural Lightweight Concrete," ACI Std. 211.2; (4) "Recommended Practice for Hot Weather Concreting," ACI Std. 605; (5) "Recommended Practice for Cold Weather Concreting," ACI Std. 306; (6) "Manual of Standard Practice for Detailing Reinforced Concrete Structures," ACI Std. 315; (7) "Recommended Practice for Evaluation of Compression Test Results of Field Concrete," ACI Std. 214; (8) "Recommended Practice for Measuring, Mixing and Placing Concrete," ACI Std. 614; (9) "Recommended Practice for Concrete Formwork," ACI Std. 347; (10) "Specification for the Design and Construction of Reinforced Concrete Chimneys," ACI Std. 505; (11) "Suggested Design of Joints and Connections in Precast Structural Concrete," ACI Report 512; (12) "Guide for Cellular Concretes Above 50 pcf and for Aggregate Concretes Above 50 pcf with Compressive Strengths Less than 2500 psl," ACI JOURNAL, February 1975 (Copies of above standards may be obtained from American Concrete Institute, P.O. Box 19150, Redford Station, Detroit, Michigan 48219); (13) "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction," AWS Std. 12.1 (American Welding Society, 2501 NW 7th St., Miami, Florida 33125).

(e) *Masonry*. The design and construction of masonry buildings shall conform to the "Concrete Masonry Handbook" [ILHR 20.24 (5)].

History: Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and rec. (3) (a), am. (3) (c) and Table 21.02, cr. (3) (c) 2., Register, February, 1985, No. 350, eff. 3-1-85.

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

(1) **EXITS FROM THE FIRST FLOOR.** Every dwelling unit shall be provided with at least 2 exits from the first floor. One of the exits shall discharge to grade. The second exit may discharge to an outside balcony or discharge to grade or discharge into an attached garage provided with an exit door which discharges to grade. An overhead garage door may not be used as an exit door. The 2 required exits from the first floor shall be located as far apart as practical.

(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. (6m) 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.** (a) Basements which are not used for sleeping shall be provided with at least one exit. The exit shall be a stairway or ramp which leads to the floor level above or discharges to grade.

(b) Basements which include spaces used for sleeping shall be provided with at least 2 exits. The 2 exits shall not be accessed by the same stairway or ramp and shall be located as far apart as practical. One exit shall be a stairway or ramp which leads to grade or a door located at the basement level which leads to grade via an exterior stairs. The second exit may be via a stairway or ramp which leads to the floor level above the basement. Windows which comply with sub. (6m) may be provided in each basement bedroom in lieu of the second exit from the basement.

(6) **EXITS FROM GROUND FLOORS.** (a) Ground floors which are not used for sleeping shall be provided with at least one exit. The exit may be a swing door or a sliding glass door which discharges directly to grade or may be via a stairway which leads to the first floor.

(b) Ground floors which include spaces used for sleeping shall be provided with at least 2 exits. The 2 exits shall not be accessed by the same stairway or ramp and shall be located as far apart as practical. One exit shall discharge to grade. The second exit may be via a stairway or ramp which leads to the first floor. Windows which comply with sub. (6m) may be provided in each ground floor bedroom in lieu of the second exit from the ground floor.

(6m) **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 in width by 24 inches in height. Nominal dimensions shall be determined by rounding up fractions of inches if they are 1/2-inch or greater or rounding down fractions of inches if they are less than 1/2-inch.

2. Except as provided in subd. 3., no portion of the window, including stops, stools, meeting rails and operator arms of awning windows, shall infringe on the required opening.

3. The movable sash of casement windows may infringe on the required opening width. The net clear opening width of casement windows shall be measured between the stops.

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

(d) The sill height shall not be more than 46 inches above the floor or the top of a permanent platform, with or without steps, installed below the window. The platform and steps, if provided, shall be as wide as the actual egress opening and have a minimum tread depth of 9 inches and maximum riser height of 8 inches.

(e) If a window which is provided as an exit is located below grade, then an areaway shall be provided. The width of the areaway shall be at least equal to the width of the exit window. The bottom of the areaway shall not be more than 46 inches below grade. The areaway shall be a

minimum of 3 feet measured perpendicular from the wall. The areaway shall be constructed to prevent rainfall flowing into the areaway from entering the dwelling.

(7) **DOORS.** One of the required exit doors from a dwelling unit shall be a swing type door at least 3 feet wide by 6 feet 8 inches high. All other required exterior exit doors shall be at least 2 feet 8 inches wide by 6 feet 4 inches high. Where double doors are provided as a required exit, the width of each door leaf shall be at least 2 feet 6 inches and the doors shall not have an intermediate mullion.

(8) **INTERIOR CIRCULATION.** All passageway doors to at least 50% of the bedrooms, at least one full bathroom, and the common-use areas such as kitchens, dining rooms, living rooms, basements, and family rooms shall be at least 2 feet 8 inches wide by 6 feet 8 inches high. Where cased or uncased openings are provided in lieu of doors, the clear width of the passageway openings shall be at least 2 feet 6 inches wide.

(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 treated, protected or naturally decay-resistive wood, concrete or metal materials. Materials may be protected by the use of paints or stains which are suitable for the material.

(b) Balconies shall be provided with guardrails in accordance with s. ILHR 21.04 (2).

(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 (6) (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.

ILHR 21.04 Stairs and elevated areas. Every exterior or interior stairs, including tub access steps but excluding those leading to attics or crawl spaces, shall conform to the requirements of this section.

(1) **LANDINGS.** (a) *Intermediate landings.* Intermediate landings shall be provided for any flight of stairs of 12 feet or more in height. Intermedi-

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ate landings located in a flight of stairs shall be at least as wide as the stairs and shall measure at least 3 feet in the direction of travel. For curved or semicircular landings, the radius of the landing shall be larger than or equal to the width of the stairway. Trim and handrails may project no more than 3-½ inches into the required width at each side of the landing.

(b) *Landings at the top and base of stairs.* A level landing shall be provided at the top and at the foot 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.* Except as provided in subds. 1 to 4, level landings shall be provided on each side of any door located at the foot or head of a stairway, regardless of the door swing. In the application of the exceptions given in subds. 1 to 4, stairways to attached garages or porches are considered to be interior stairways.

1. Exception. A landing shall not be required between the door and the head of interior stairs, provided the door does not swing over the stairs.

2. Exception. A landing shall not be required between the door and the head of an interior stairway of 2 or fewer risers, regardless of the doorswing.

3. Exception. A landing shall not be required between a sliding glass door and the head of an exterior stairway of 3 or fewer risers.

4. Exception. The exterior landing, platform or sidewalk at an exterior doorway shall be located not more than 8 inches below the interior floor elevation. The landing platform shall have a length at least equal to the width of the door.

(2) **HANDRAILS AND GUARDRAILS.** (a) *Handrails.* Every stairway of more than 3 risers shall be provided with at least one handrail for the full length of the stairway. Handrails shall be provided on all open sides of stairways of more than 3 risers. Handrails shall be provided on the side of winder steps where the tread is widest. Stairway handrails shall be continuous except where newel posts may intervene.

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

(c) *Handrail and guardrail details.* 1. Height. Handrails shall be located at least 30 inches, but not more than 34 inches, above the nosing of the treads. Guardrails shall be located at least 36 inches above the upper surface of the floor.

2. Open railings. Open guardrails or handrails shall be provided with intermediate rails or an ornamental pattern to prevent the passage of a sphere with a diameter larger than 6 inches.

3. Clearance. The clearance between the handrail and the wall surface shall be at least 1-½ inches.

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

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

6. Handrail size. The diameter or width of the gripping surface of stair handrails shall be no more than 2½ inches.

(3) STAIR DETAILS. Stairs shall meet the following requirements:

(a) *Minimum width.* Every stairway shall measure at least 3 feet in width. Trim and handrails may project no more than 3½ inches into the required width at each side of the stairs.

(b) *Headroom.* Every stairs shall be provided with a minimum headroom clearance of 6 feet 4 inches. The minimum clearance shall be measured vertically from a line parallel to the nosing of the treads to the ceiling or soffit directly above that line.

(c) *Treads and risers.* 1. Risers shall not exceed 8 inches in height, measured vertically from tread to tread. Treads shall be at least 9 inches wide, measured horizontally from nosing to nosing.

2. Within stairways, tread widths and riser heights may vary in uniformity by a maximum of 3/16 inches. Variations in uniformity shall not cause the minimum and maximum dimensions specified in subd. 1. to be exceeded.

(d) *Winders.* Winder steps may be used in stairs where the length of the tread is at least 3 feet and the winder tread measures at least 7 inches in width at a point one foot from the narrow end of the tread.

(e) *Spiral stairs.* Spiral stairs may be used as an exit stairs. The tread shall measure at least 26 inches from the outer edge of the supporting column to the inner edge of the handrail and at least 7 inches in width from nosing to nosing at a point one foot from the narrow end of the tread.

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 ILHR 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.

ILHR 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.

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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 at least 30 inches, but not more than 34 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 larger than 9 inches 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 should 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 ILHR 21.04 (3) (f), cr. (intro.), Register, January, 1989, No. 397, eff. 2-1-89.

ILHR 21.045 Ramps. Every exterior or interior ramp which leads to or from a required exit shall comply with the requirements of this section. Register, March, 1992, No. 435

(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 mounted so that the top of the handrail is located between 30 to 34 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 larger than 9 inches.

(d) The clear space between the handrail and any adjoining wall shall be at least 1-1/2 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.

ILHR 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 need not be provided with 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, kitchens and bathrooms by means of openable exterior doors, skylights or windows. The net area of the openable exterior doors, skylights or windows shall be at least 3.5% of the net floor area of the room. 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.

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

(3) **ATTIC VENTILATION.** Ventilation above the ceiling/attic insulation shall be provided as specified in either s. ILHR 22.05 (3) (a) or 22.11 (3) (a).

(4) **CRAWL SPACE VENTING.** Unheated crawl spaces shall be vented in accordance with either s. ILHR 22.05 (3) (b) or 22.11 (3) (b). All crawl spaces shall be provided with a vapor retarder that has a transmission rate of no more than 0.1 perm. All decayable organic material and topsoil shall be removed from crawl space floors prior to the placement of the vapor retarder.

(5) **SAFETY GLASS.** Glass in all interior and exterior doors, sliding doors, storm doors, adjacent sidelights of doors, bathtub enclosures, shower doors, and any fixed or operating flat glass panels within 2 feet of doors and less than 2 feet from the floor shall be safety glass.

History: Cr. Register, November, 1979, No. 287, eff. 6-1-80; r. and recr. (1) and (2), Register, February, 1985, No. 350, eff. 3-1-86; 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.

ILHR 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. 3-1-86.

ILHR 21.07 Attic and crawl space access. (1) **ATTIC.** Attics with 30 inches of clearance or more 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. ILHR 81-86, Plumbing Code or ch. ILHR 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.

ILHR 21.08 Firestopping, draftstopping and fire separation. (1) **FIRE-STOPPING LOCATIONS.** Firestopping shall be provided in 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 such as occur at soffits, drop ceilings and cove ceilings; and

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

(1m) **EQUIVALENT FIRESTOPPING REQUIREMENTS FOR ENVELOPE DWELLINGS.** Firestopping for envelope-type dwellings shall comply with this subsection.

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(a) Vertical walls which form any air passageway shall be lined with gypsum wallboard or other material to provide a 15 minute thermal barrier.

(b) At least 3 smoke detectors shall be placed in the air passageways. A smoke detector shall be placed in the ceiling passageway and in two opposite walls or the smoke detectors shall be placed as far apart as practical. The smoke detectors shall be a hardwired type. The alarm of the detector shall be audible in the occupied areas of the dwelling, when actuated.

Note: Also see s. ILHR 23.08 (10), Air Passageways of Envelope Dwellings.

(2) **FIRESTOPPING MATERIALS.** Firestopping shall consist of 2-inches nominal lumber or 2 thicknesses of one-inch nominal lumber or one thickness of 23/32-inch plywood with joints backed by 23/32-inch plywood. Oriented strand board, particle board and waferboard may be used in place of plywood. Gypsum wallboard or other noncombustible material may also be used for firestopping. Noncombustible mineral-based insulation may be used where the least dimension of the opening to be firestopped does not exceed 4 inches.

Note: Any nonrigid material used as firestopping, such as batt insulation, must completely fill the opening and be tightly packed to maintain a permanent installation.

(3) **DRAFTSTOPPING LOCATIONS.** Draftstopping shall be provided in the following locations:

(a) In floor-ceiling assemblies above and in line with the tenant separation, when tenant separation walls do not extend to the floor sheathing above;

(b) In the attic, mansard, overhang or other concealed roof space above and in line with the tenant separation when tenant separation walls do not extend to the roof sheathing above. Where flat roofs with solid joist construction are used, draftstopping over tenant separation walls is not required; and

(c) At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels.

(4) **DRAFTSTOPPING MATERIALS.** Draftstopping shall not be less than ½-inch gypsum board, ¾-inch plywood or other approved noncombustible materials. Noncombustible mineral-based insulation may be used where the least dimension of the opening to be draftstopping does not exceed 4 inches. Metallic firestops shall be used for metal vents and chimneys.

(5) **FIRE SEPARATION.** Garage space and accessory buildings shall be separated from the dwelling unit in accordance with Table 21.08 and the following requirements:

TABLE 21.08

Perpendicular Distance from Dwelling Wall to the Closest Garage Wall or Accessory Building Wall	Fire-rated Construction
0 to 5 feet	¾-hour
5 to 10 feet with windows in either wall	¾-hour
5 to 10 feet without windows in either wall	No requirements
10 feet or more	No requirements

(a) The garage shall be separated from habitable and nonhabitable areas of the dwelling unit, as well as attics and soffit areas. The vertical separation shall extend from the top of the concrete or masonry foundation to the underside of the roof sheathing or to fire-rated ceiling construction. The fire-rated construction shall conform with Table 21.08.

1. Exception. Gypsum drywall on the garage side may be untaped provided at least ½-inch firecode drywall is used on the garage side and all edges are tightly fitted.

2. Exception. Gypsum drywall on the garage side may be untaped provided at least ½-inch drywall is used on both sides of the wall separating the garage and the dwelling and all edges are tightly fitted.

3. Exception. Two layers of ½-inch drywall on the garage side may be untaped where no drywall is installed on the interior provided all edges are tightly fitted.

(b) Beams, columns and bearing walls that are exposed to the garage and which provide support for separated spaces shall be protected by one of the methods specified in par. (a) 1. to 3. or other minimum 45-minute fire-resistive rated protection.

(c) The door and frame assembly between the garage and the dwelling unit shall have a minimum fire rating of 20 minutes. A 1-¾-inch solid core wood or insulated metal door may be installed with a pair of 1-½-inch steel hinges in a 1-7/32-inch minimum thick solid wood frame with a ½-inch thick door stop.

(d) Garage floors shall be constructed of concrete or noncombustible materials which are impermeable to petroleum products. Concrete garage floors shall be at least 4 inches thick placed over at least 4 inches of granular fill. The garage floor shall slope toward the exterior garage opening or shall slope to an interior drain.

Note: See s. ILHR 82.34 (4) (b), Uniform Plumbing Code, for floor drain requirements.

(e) Access openings in fire separation walls or ceilings shall maintain the required separation and shall have any drywall edges protected from physical damage. The cover or door of the opening shall be permanently installed with hardware which will maintain it in the closed position when not in use.

(6) LIVING UNIT SEPARATION. (a) In 2-family dwellings, living units shall be separated from each other, from common areas, and from exit access corridors by construction protected with not less than one layer of ½-inch Type X gypsum wallboard or equivalent on each side of the wall.

(b) Any door and frame assembly installed in the living unit separation shall:

1. Have a minimum fire rating of 20 minutes; or
2. Consist of a minimum 1 3/4-inch solid core wood or insulated metal door installed with 1 1/2-inch steel hinges in a 1 7/32-inch thick solid wood frame with a 1/2-inch thick door stop.

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.

ILHR 21.09 Smoke detectors. (1) Listed and labeled smoke detectors shall be installed and maintained in accordance with ss. 101.645 (3) and 101.745 (4), Stats., and the specifications of the manufacturers of the detectors in each dwelling unit the initial construction of which was commenced on or after the effective date of this code, June 1, 1980.

Note 1: Section 50.035 (2), Stats., created by 1983 Wis. Act 363 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 2: 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 employe 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 3: 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.

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.

ILHR 21.10 Protection against decay and termites. (1) GENERAL. Except as provided in sub. (2), wood used in the following locations shall be either pressure treated with preservative or be a naturally durable, decay resistant species of lumber. Wood that is not pressure treated with preservative shall be protected against termites unless naturally termite resistant.

(a) Wood floor joists closer than 18 inches or wood girders closer than 12 inches to earth;

(b) Sills which are less than 8 inches above exposed earth, and rest on concrete or masonry walls or concrete floors.

(c) Ends of wood girders entering masonry or concrete walls and having clearances of less than ½ inch on the tops, sides and ends;

(d) Wood siding having a clearance of less than 6 inches from the earth;

(e) Wood embedded in earth; and

(f) Bottom plates of load bearing walls on slab floors of basements and garages.

(2) EXCEPTION. Wood used in basements as furring or finish material or in nonbearing walls need not comply with this section.

(3) IDENTIFICATION. (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 in accordance with the adopted standards of the American Wood Preservers Bureau or of the American Wood Preservers Association.

(b) Pressure treated wood used below grade in foundations shall be labeled to show conformance with AWPAC C-22 "Lumber and Plywood for Permanent Wood Foundations - Pressure Processes" or AWPB FDN "Quality Control Program for Softwood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservatives for Ground Contact Use in Residential and Light Commercial Foundations."

Note: Heartwood of redwood, cypress, black walnut, catalpa, chestnut, osage 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.

ILHR 21.11 Foam plastic insulation. Foam plastic insulation shall have a flame-spread rating of not more than 75 and a smoke-developed rating of not more than 450.

Note: The department will accept foam plastic insulation tested in accordance with ASTM E-84.

(1) THERMAL BARRIERS. Foam plastic insulation shall be protected in accordance with this subsection. One half-inch gypsum wallboard, 19/32-inch plywood, oriented strand board, particle board or waferboard, or nominal one-inch tongue and groove or lap-jointed sawn lumber are acceptable as 15-minute thermal barrier materials.

(a) *Walls and ceilings.* Foam plastic insulation may be used within the stud space of a wood frame wall, or on the inside surface of a wall or ceiling if the foam plastic insulation is fully protected by a 15-minute thermal barrier.

(b) *Masonry or concrete components.* Foam plastics may be used within the cavity of a masonry wall, in cores of masonry units, or under a masonry or concrete floor system where the interior of the dwelling is separated from the foam plastic insulation by a minimum one-inch thickness of masonry or concrete or other approved 15-minute thermal barrier materials.

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(c) *Roofs.* Roof coverings may be applied over foam plastic insulation where the interior of the dwelling is separated from the foam plastic insulation by plywood sheathing, oriented strand board, particle board or waferboard at least 15/32-inch in thickness, or other approved 15-minute thermal barrier materials.

(d) *Doors.* Foam plastic insulation having a flame-spread rating of 75 or less may be used in doors when the door facing is of metal having a minimum thickness of 0.032-inch aluminum or No. 26 gauge sheet metal.

(2) **SPECIFIC APPROVAL.** Foam plastic insulation not meeting the requirements of this section may be approved by the department based upon diversified tests which evaluate materials or assemblies representative of actual end use applications.

Note: Approved diversified tests may include, but are not limited to: ASTM E-84 (tunnel test), ASTM E-19 fire test, full-scale corner test, enclosed room corner test and ignition temperature test.

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. 436, eff. 4-1-92.

Subchapter III — Excavations

ILHR 21.12 Grade. The grade shall slope away from the dwelling to provide drainage away from the dwelling.

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

ILHR 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.

ILHR 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.

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(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

ILHR 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.** 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.

(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:

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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.

ILHR 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 the ground. 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 1-½ 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. ILHR 21.03 (6m), 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.

ILHR 21.17 Drain tiles. (1) **WHERE REQUIRED.** Drain tiles or pipe shall be provided around footings located in soils where ground water levels occur above the elevation of the footing.

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(a) *Municipalities exercising jurisdiction.* Municipalities exercising jurisdiction under chs. ILHR 20 to 25 may determine the soil types, natural and seasonal groundwater levels for which drain tile is required.

(b) *All other areas.* Drain tiles shall be required whenever a soil test shows evidence of periodic or seasonal saturation at any depth less than 72 inches. When the on-site evaluation shows no evidence of saturation, drain tiles need not be installed. Under all other conditions, drain tiles shall be installed on each side of foundation walls at the footing level.

(2) **MATERIALS AND INSTALLATION REQUIREMENTS.** (a) Drain tiles or pipes used for foundation drainage shall be at least 3 inches inside diameter.

(b) Where individual tiles are used, they shall be laid with $\frac{1}{8}$ -inch open joints. Joints between the tiles shall be covered with a strip of sheathing paper or asphalt or tar saturated felt.

(c) The tile or pipe shall be placed upon at least 2 inches of washed rock and shall be covered with at least 12 inches of washed rock which meets the following criteria:

1. 90-100% of the rock must pass a $\frac{3}{8}$ -inch sieve; and
2. 20-25% of the rock must pass a $\frac{1}{8}$ -inch sieve.

(d) The basement slab shall be placed on at least 4 inches of gravel.

(e) Bleeder tiles shall be provided to connect the exterior footing drain tile to the interior footing tile and shall be placed in the footing such that the tiles are spaced at 8 foot intervals.

(f) The drain tiles or pipe which lead from the footing tiles to the sump pit shall be laid at a grade of not less than $\frac{1}{8}$ inch per foot leading to the sump pit. The remaining drain tiles or pipe shall be level or graded downward to the line which leads to the sump.

(3) **DRAIN TILE DISCHARGE.** Drain tiles shall be connected to a sump pit. The sump shall discharge to natural grade or be equipped with a pump to discharge water away from the dwelling via surface drainage channels.

(a) *Sumps.* 1. *Construction and installation.* The sump shall have a rim extending at least one inch above the floor immediately adjacent to the sump, except where the sump is installed in an exterior meter pit. The sump shall have a removable cover of sufficient strength for anticipated loads. The sump shall have a solid bottom.

2. *Location.* All sumps installed for the purpose of receiving clear water, basement or foundation drainage water shall be located at least 15 feet from any water well.

3. *Size.* The size of each clear water sump shall be as recommended by the sump pump manufacturer, but may not be smaller than 16 inches in diameter at the top, 14 inches in diameter at the bottom and 22 inches in depth.

(b) *Sump pump systems.* 1. *Pump size.* The pump shall have a capacity appropriate for anticipated use.

2. Discharge piping. Where a sump discharges into a storm building drain or sewer, a free flow check valve shall be installed.

(4) **SUMP DISCHARGE DISPOSAL.** (a) *Storm sewer.* Storm water, surface water, groundwater and clear water wastes shall be discharged to a storm sewer system or a combined sanitary-storm sewer system where available. Combined public sanitary-storm sewer systems shall be approved by the department of natural resources. Combined private sanitary-storm sewer systems shall be approved by the department.

(b) *Other disposal methods.* 1. Where no storm sewer system or combined sanitary-storm sewer system is available or adequate to receive the anticipated load, the storm water, surface water, groundwater and clear water wastes shall be discharged in accordance with local governmental requirements.

2. Where approved by the local governmental authority, storm water, surface water, groundwater and clear water wastes of the properties of one- and 2-family dwellings may be discharged onto flat areas, such as streets or lawns, so long as the water flows away from the buildings and does not create a nuisance.

(c) *Segregation of wastes.* 1. a. Except as provided in subd. 3., where a sanitary sewer system and a storm sewer system are available, the drain piping for storm water or clear water wastes may not connect to any part of the sanitary drain system.

b. Where a combined sanitary-storm sewer system is available, storm water wastes, clear water wastes and sanitary wastes may not be combined until discharging to the building sewer.

2. Storm water wastes and clear water wastes may not be combined until discharging into the storm building drain.

3. a. The clear water wastes from a drinking fountain, water heater relief valve, storage tank relief valve or water softener shall be discharged to either a sanitary drain system or a storm drain system.

b. The clear water wastes from equipment other than those listed in subpar. a. may be discharged to a sanitary drain system if not more than 20 gallons of clear water wastes per day per building are discharged.

Note: Subsections (3) (a) and (4) are excerpts from the state uniform plumbing code, s. ILHR 82.36.

(5) **OTHER SYSTEMS.** Other equivalent engineered foundation drainage systems may be submitted to the department for review and approval.

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. 436, eff. 4-1-92.

Subchapter V — Foundations

ILHR 21.18 Foundations. 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. Lateral support such as floor slabs or framing shall be provided at the base of walls. Lateral support shall be provided at the top of foundation walls in accordance with

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Table 21.18, or shall be provided by a ledger block at the perimeter of the floor or other system designed through structural analysis.

TABLE 21.18

BOLT SIZE AND SPACING FOR TOP RESTRAINT OF BASEMENT WALLS¹

Nominal Wall Thickness (Inches)	Maximum Height ² of Unbalanced Fill (Feet)	Anchor Bolt Size ³ And Spacing
8	4	1/2" at 60"
	5	1/2" at 40"
	6	5/8" at 32"
10	6	5/8" at 32"
	7	5/8" at 24"
	8	3/4" at 20"
12	7	5/8" at 24"
	8	3/4" at 20"
	9	7/8" at 18"
	10	1" at 16"

¹ Soil equivalent fluid weight is assumed to be 30 pcf.

² Unbalanced fill is the difference in elevation between outside grade and the basement floor.

³ Anchor bolts shall be embedded a minimum of 7 inches into concrete and a minimum of 15 inches into masonry. One bolt shall be placed a distance from the outside corner equal to between one and 1-1/2 wall thickness.

(1) **CONCRETE FOUNDATION WALLS.** Unless designed through structural analysis, the minimum thickness of concrete foundation walls shall be determined from Table 21.18-A, but in no case shall the thickness be less than the thickness of the wall it supports.

TABLE 21.18-A

CONCRETE WALL THICKNESSES

Type of Concrete	Nominal Thickness (inches)	Maximum Height of Unbalanced Fill ¹ for Material of Wall Being Supported (Wood frame - feet)
3000 psi	6	6.5
Unreinforced concrete	8	8
	10	9
	12 ²	10
	14	11.5

¹ Unbalanced fill is the difference in elevation between the outside grade and the basement floor.

² 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.

(2) **MASONRY FOUNDATION WALLS.** Unless designed through structural analysis, the masonry foundation walls shall be constructed in accordance with the following requirements:

(a) *Unreinforced masonry wall; thickness.* The minimum thickness of unreinforced masonry foundation walls shall be determined by Table 21.18-B, but in no case shall the thickness be less than the thickness of the wall it supports.

(b) *Reinforced masonry wall; thickness.* Reinforced masonry walls shall be reinforced in accordance with the requirements of Tables 21.18-C or 21.18-D. In partially reinforced masonry walls, vertical reinforcement

shall be provided on each side of any opening, at each wall corner, and at intervals indicated in the Table 21.18-D.

(c) *Wall design.* The depth below grade, wall height, and pilaster or reinforcement spacing may exceed the maximum values indicated in Tables 21.18-B, -C or -D if the design is based on engineering analysis.

(d) *Subsurface drainage.* Subsurface drainage shall be provided if required by s. ILHR 21.17.

TABLE 21.18-B

MAXIMUM DEPTH BELOW GRADE* (HEIGHT OF FILL) AND THICKNESSES FOR VARIOUS CONCRETE MASONRY FOUNDATION WALLS WITHOUT PILASTERS

Wall Construction Nominal Thickness, in., and Type of Unit	Maximum Depth Below Grade, feet, when Walls Support:	
	Frame Construction	Masonry, or Masonry Veneer Construction
Hollow-Load-Bearing:		
8"	5' (6')	6'
10"	6' (7')	7'
12"	7'	7'
Solid Load-Bearing:		
8"	5' (7')	7'
10"	6' (7')	7'
12"	7'	7'

* In well drained sand and gravel soils, the height of the unbalanced fill may be increased to the values shown in parentheses.

TABLE 21.18-C

MAXIMUM DEPTH BELOW GRADE (HEIGHT OF FILL) FOR CONCRETE MASONRY FOUNDATION WALLS WITH PILASTERS

Nominal Wall Thickness (inches)	Type of Masonry (Load Bearing)	Type of Fill ¹	Minimum Nominal Pilaster ² width × depth (inches)	Maximum Pilaster Spacing o.c. (feet)	Maximum Height of Fill ³ (feet)	Maximum Wall Height ⁴ (feet)
8	Hollow	Granular	16 × 12	20	6.5	7.5
8	Hollow	Other	16 × 12	10	6.0	7.5
8	Solid	Granular	16 × 12	20	7.0	7.5
8	Solid	Other	16 × 12	12	6.5	7.5
10	Hollow	Granular	16 × 14	18	8.0	8.0
10	Hollow	Other	16 × 14	15	7.0	8.0
10	Solid	Granular	16 × 14	30	8.0	8.0
10	Solid	Other	16 × 14	22	7.0	8.0
12	Hollow	Granular	16 × 16	30	8.0	8.0
12	Hollow	Other	16 × 16	20	8.0	8.0
12	Solid	Granular	16 × 16	30	8.0	8.0
12	Solid	Other	16 × 16	30	8.0	8.0

¹ Granular fill is sand, sand and gravel or washed gravel. See "Other" for all other fill types or soils which are not well drained.

² All cells of hollow units used to construct pilasters shall be filled with grout.

³ The height of fill equals the vertical distance between the finished exterior grade and the basement floor or inside grade.

⁴ The wall height equals the clear height between floors providing lateral support.

TABLE 21.18-D

MAXIMUM DEPTH BELOW GRADE FOR PARTIALLY
REINFORCED MASONRY WALLS

Wall Construction Nominal Thickness and Type of Unit	Total Maximum Wall Height ¹ (feet - inches)	Minimum Reinforcement Size and Maximum Spacing Center to Center	Maximum Depth Below Grade ² (feet - inches) for Fill Type ³	
			Granular	Other
			8-inch Hollow Load Bearing	8-4 8-4 8-4 8-4
10-inch Hollow Load Bearing	8-4 8-4 8-4 8-4	#5 bars @ 8 ft. #6 bars @ 8 ft. #7 bars @ 8 ft. #8 bars @ 8 ft.	7-0 7-6 8-0 8-4	6-6 7-0 7-6 8-0
12-inch Hollow Load Bearing	8-4 8-4 8-4 8-4	#4 bars @ 8 ft. #5 bars @ 8 ft. #6 bars @ 8 ft. #7 bars @ 8 ft.	6-6 7-6 8-0 8-4	6-0 6-6 7-6 8-0

¹ The height of the wall equals the clear height between floors providing lateral support.

² Depth below grade equals the vertical distance between the finished exterior grade and the basement floor or inside grade.

³ Granular fill is sand, sand and gravel or washed gravel. See "Other" for all other fill types or soils which are not well drained.

(3) **WOOD FOUNDATIONS.** Wood foundations shall be designed and constructed in accordance with the National Forest Products Association standard, "The All-Weather Wood Foundation System, Basic Requirements, Technical Report No. 7" and the following exceptions. The thickness of the foundation wall shall be no less than the thickness of the wall it supports.

(a) *Exception.* Section 3.3.1, *Fasteners.* 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 National Forest Products Association.

(b) *Materials.* All lumber and plywood shall be pressure treated with preservative and labeled to show conformance with AWPAC-22 or AWPBFDN.

Note: The department will accept materials which meet the "Quality control Program for Soft-Wood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservatives for Ground Contact Use in Residential and Light Commercial Foundations," published by the American Wood Preservers Bureau.

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.

Subchapter VI — Floors

ILHR 21.19 Floor design. Floors shall support all dead loads plus the minimum unit live loads as set forth in s. ILHR 21.02. The live loads shall be applied to act vertically and uniformly to each square foot of Register, March, 1992, No. 435

horizontal floor area. Basements shall be provided with wood or concrete or similar type floors that comply with s. ILHR 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.

ILHR 21.20 Concrete floors. When concrete floors are provided, the thickness of the concrete shall measure at least 3 inches. In clay soils, a 4-inch thick base course shall be placed in the subgrade consisting of clean graded sand, gravel or crushed stone. The base course may be omitted in sand and gravel soils.

History: Cr. Register, November, 1979, No. 287, eff. 6-1-80; am. Register, January, 1989, No. 397, eff. 2-1-89.

ILHR 21.205 Wood floors in contact with ground. Wood may be used for floors in contact with ground unless prohibited by ordinance by the municipality exercising jurisdiction in accordance with s. ILHR 20.20. The floor shall conform to the standards specified in s. ILHR 20.24 (4).

History: Cr. Register, January, 1989, No. 397, eff. 2-1-89.

ILHR 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.

ILHR 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. ILHR 21.02 (3) (a). The minimum live loads shall be determined from s. ILHR 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 RESTING ON MASONRY WALLS.** On masonry walls the floor joists shall rest upon a mortar filled core concrete block or a solid top concrete block or a sill plate. The dimensions of the sill plate shall not be less than 2 inches by 6 inches. The mortar used shall be determined as in s. ILHR 21.26 (3).

(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.

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(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.** The minimum bearing for wood joists shall be at least 1 ½-inches on wood or metal and at least 3 inches on masonry or concrete. Wood beams and girders shall have at least 3 inches of bearing. Floor joists framing over beams from opposite sides shall either lap at least 3 inches and be securely fastened together, or when framed end-to-end, the joists shall be provided with blocking or shall be securely fastened together by ties, straps or plates. Tail ends of floor joists shall not go beyond the beam by more than 8 inches.

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

(a) *Notching.* 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 ¼ the depth of the joist. Notches over supports may extend the full bearing width of the support.

(b) *Boring.* Holes bored in floor joists shall be located no closer than 2 inches to the top or bottom edges of the joist. Where holes are located outside the middle 1/3 of the span, the diameter of the hole shall not exceed 1/3 the depth of the joist. Where the joist is notched, the hole shall not be closer than 2 inches to the notch.

(6) **OVERHANG OF FLOORS.** (a) Unless designed through structural analysis under s. ILHR 21.02, floor joists which are at right angles to the supporting wall shall not be cantilevered more than 2 feet over the supporting wall, and shall support only the wall and roof above it.

(b) Where overhanging floor joists are perpendicular to the main joists, a double floor joist may be used to support lookout joists extending not more than 2 feet over the wall line below. The double joist shall be located a distance of twice the overhang from the lower wall. The lookout joists shall be fastened to the double joists with metal hangers. Lookout joists that extend more than 2 feet over the wall line below shall be designed through structural analysis under s. ILHR 21.02.

(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.

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

Column Spacing	Roof/Ceiling and One Floor				Roof/Ceiling + One Floor/Ceiling + One Floor			
	Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²		Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²	
	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1
24 ft. wide house: 8 ft.	8x10	10x10	—	—	8x12	10x12	—	—
	6x12	6x12	—	—	6x14	8x14	—	—
	8x12	10x12	M 10x9	M 10x9	10x14	10x14	M 12x11.8	M 12x11.8
	6x14	8x14	W 6x12	W 8x10	8x16	8x16	W 8x15	W 8x15
	12x12	10x14	W 10x11.5	M 12x11.8	14x14	14x14	W 12x16.5	W 12x16.5
10 ft.	10x14	8x16	S 7x15.3	W 8x15	10x16	12x16	S 8x23	W 8x20
	—	—	W 12x16.5	W 12x16.5	—	—	W 12x22	W 14x22
12 ft.	—	—	W 10x17	W 6x25	—	—	W 8x28	W 8x31
	—	—	—	—	—	—	—	—
26 ft. wide house: 8 ft.	10x10	10x10	—	—	10x12	10x12	—	—
	6x12	8x12	—	—	8x14	8x14	—	—
	10x12	10x12	M 10x9	S 6x17.25	10x14	12x14	M 12x11.8	W 12x14
	8x14	8x14	W 8x10	W 8x13	8x16	8x16	W 8x15	W 8x17
	10x14	10x14	M 12x11.8	M 12x11.8	14x14	12x16	W 12x16.5	W 10x19
10 ft.	8x16	8x16	W 8x15	W 6x20	12x16	10x18	W 8x20	W 8x24
	—	—	W 12x16.5	W 10x19	—	—	W 14x22	W 14x22
12 ft.	—	—	W 8x20	W 8x24	—	—	W 8x31	W 8x35
	—	—	—	—	—	—	—	—
28 ft. wide house: 8 ft.	10x10	8x12	—	—	10x12	10x12	—	—
	8x12	4x16	—	—	8x14	8x14	—	—
	10x12	12x12	S 6x17.25	W 10x11.5	12x14	12x14	W 12x14	W 12x14
	8x14	8x14	W 8x13	W 8x13	8x16	10x16	W 8x17	W 10x15
	10x14	12x14	M 12x11.8	W 12x14	12x16	12x16	W 10x19	M 14x17.2
10 ft.	8x16	10x16	W 8x15	W 8x17	10x18	10x18	W 8x24	W 8x24
	—	—	—	—	—	—	—	—
12 ft.	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—

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Column Spacing	Roof/Ceiling and One Floor				Roof/Ceiling + One Floor/Ceiling + One Floor			
	Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²		Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²	
	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1
28 ft. wide house (cont) 15 ft.	—	—	W 10x19 W 8x24	M 14x17.2 W 8x24	—	—	W 14x22 W 8x35	W 14x26 W 8x35
30 ft. wide house: 8 ft.	10x10 8x12	8x12 6x14	—	—	10x12 8x14	12x12 8x14	—	—
10 ft.	10x12 8x14	12x12 10x14	S 6x17.25 W 8x13	W 10x11.5 W 8x13	12x14 10x16	12x14 10x16	W 12x14 W 10x15	W 12x14 S 8x18.4
12 ft.	12x14 8x16	12x14 10x16	W 12x14 W 8x17	W 12x14 W 8x17	12x16 10x18	14x16 12x18	M 14x17.2 W 8x24	M 14x17.2 W 8x24
15 ft.	—	—	M 14x17.2 W 8x24	W 10x21 W 8x28	—	—	W 14x26 W 8x35	W 14x26 W 10x33
32 ft. wide house: 8 ft.	8x12 6x14	8x12 6x14	—	—	12x12 8x14	12x12 10x14	—	—
10 ft.	12x12 8x14	12x12 10x14	W 10x11.5 W 8x13	W 10x11.5 W 6x16	12x14 10x16	14x14 10x16	W 12x14 S 8x18.4	W 12x16.5 W 10x17
12 ft.	12x14 10x16	14x14 10x16	W 12x14 W 10x15	W 12x14 W 10x17	14x16 12x18	14x16 12x18	M 14x17.2 W 8x24	W 12x22 W 8x28
15 ft.	—	—	M 14x17.2 W 8x24	W 12x22 W 8x28	—	—	W 14x26 W 12x27	W 14x26 W 12x27

¹ 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.

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

³ 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.

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

HOUSE WIDTH	F _b = 800 psi		F _b = 1000 psi		F _b = 1200 psi		F _b = 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	12-5	3-2x12	14-8	3-2x12	15-10	3-2x12
	13-10	4-2x12	13-7	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	3-2x8
	7-3	4-2x8	8-2	4-2x8	8-11	4-2x8	9-3	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

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HOUSE WIDTH	$F_b = 800$ psi		$F_b = 1000$ psi		$F_b = 1200$ psi		$F_b = 1400$ 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
28 ft.	5-10	3-2x8	6-6	3-2x8	7-2	3-2x8	7-8	3-2x8
	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	3-2x8
	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
	9-5	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	3-2x8
	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

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

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

³ 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.

⁴ 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.

(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. Bridging shall be provided at intervals not exceeding 8 feet where the nominal depth to thickness ratio of sawn lumber framing is greater than 6 to 1. Bridging shall be provided for engineered framing components when required by the manufacturer.

TABLE 21.22-B

ALLOWABLE SPANS FOR PLYWOOD FLOOR SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS¹

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

¹ 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.

² Span Rating appears on all panels in the construction grades listed in footnote 1.

³ 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 25/32-inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 165 pounds per square foot.

⁴ 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.

⁵ May be 24 inches if 25/32-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 ¹	Minimum Plywood Thickness (Inches)
Groups 1, 2, 3, 4, 5 APA UNDERLAYMENT INT (with interior or exterior glue) APA UNDERLAYMENT EXT APA C-C Plugged EXT	Over Smooth Subfloor	1/4
Same Grades as Above But Group 1 Only	Over Lumber Subfloor or Other Uneven Surfaces	11/32
APA UNDERLAYMENT Sanded Exterior Grade	Over Lumber Floor Up to 4" Wide. Face Grain Must Be Perpendicular to Boards	1/4
	Over 16" Joist Spacing, 19/32 Subfloor, Under Tile With Organic Adhesive	11/32
	Over 16" Joist Spacing, 19/32 Subfloor, Under Tile With Epoxy Mortar	15/32 ²

¹ Place face grain across supports and end joints over framing.

² 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^{1,2}

Plywood Grade	Plywood Species Group	Maximum Support Spacing ³		
		16" o.c. Panel Thickness (inches)	20" o.c. Panel Thickness (inches)	24" o.c. Panel Thickness (inches)
Sanded exterior type	1	1/2	5/8	3/4
	2 & 3	5/8	3/4	7/8
	4	3/4	7/8	1
Underlayment C-C Plugged Sturd-I-Floor ⁴	All Groups	APA Rated Sheathing and APA Rated Sturd-I-Floor shall be installed consistent with their rating.		

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

² Unsupported edges shall be tongue and groove or blocked except where 1/4-inch underlayment or 25/32-inch finish floor is used.

³ 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.

⁴ 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	11/16	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; renum. (8) (c) and (d) to be (8) (d) and (e) and am. (8) (d), renum. Table 21.22-A and D to be Table 21.22 A1 and E, cr. (8) (c), Table 21.22 A2, r. Register, March, 1992, No. 435

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.

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

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

Subchapter VII — Walls

ILHR 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.

ILHR 21.24 Exterior covering. The exterior walls shall be faced with a weather-resistant covering.

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

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

(1) **STUD SIZE AND SPACING.** (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) *Corner posts.* Posts or multiple studs shall be provided at the corners of the walls.

(c) *Wood posts or columns.* Posts and columns shall be anchored to resist loads.

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TABLE 21.25-A
MAXIMUM SPACING AND HEIGHT OF STUDS

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 & better	12	24	24	12	24
2x6 or larger	No. 3 & better	18	24	24	16	24

N/P = Not permitted.

Note: A 3-story frame house with walls constructed of 2 x 4 studs would require a 12-inch stud spacing on the lowest level, a 16-inch stud spacing on the intermediate level, and a 24-inch stud spacing on the upper level.

(d) *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 5/16 inch thick for 16-inch stud spacing and not less than 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 1/4 inch wide; or

4. Other approved wind bracing materials.

Note: See Appendix for acceptable nailing schedule.

(2) *TOP PLATES.* Studs at bearing walls shall be capped with double top plates. End joints in double top plates shall be offset at least 48 inches. Double top plates shall be overlapped at the corners and at intersections with partitions. The plate immediately above the stud shall be broken directly over the stud.

(a) *Exceptions.* 1. A single top plate may be used in lieu of a double top plate where the rafter is located directly over the stud and the plate is securely tied at the end joints, corners and intersecting walls. Single top plates shall be broken directly over the 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. ILHR 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. Where 2 x 6 framing is used in bearing walls, the number of shoulder studs may be reduced to one.

(c) *Flashing*. Unless sealed or caulked, flashing shall be provided at the top and sides of all exterior window and door openings.

(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 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) **WALL SHEATHING**. Any exposed plywood panel siding and plywood wall sheathing shall conform to the requirements shown in Table 21.25-E.

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	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	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: 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 $\sqrt{1400/1000} = 5.9$ feet.

TABLE 21.25-E

EXPOSED PLYWOOD PANEL SIDING

Minimum Thickness ¹	Minimum No. of Plys	Stud Spacing (Inches) Plywood Siding Applied Direct to Studs or Over Sheathing
3/8"	3	16 ²
1/2"	4	24

¹ Thickness of grooved panels is measured at bottom of grooves.

² May be 24 inches if plywood siding applied with face grain perpendicular to studs or over one of the following: (a) one-inch board sheathing; (b) 1/2-inch or 15/32-inch plywood sheathing; (c) 3/8-inch plywood sheathing with face grain of sheathing perpendicular to studs.

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.

ILHR 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.** All masonry units shall be free from physical defects which interfere with laying of the unit and impair the compressive strength 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.

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(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 2-½ 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
Foundations:	
Footings	M, S
Walls of solid units	M, S, N
Walls of hollow units	M, S
Hollow walls	M, S
Masonry other than foundation masonry:	
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 PROPORTION¹

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

¹ All cements are one cubic foot per sack; lime equals 1-1/4 cubic foot per sack.

² Limited to walls with a maximum depth of 5 feet below grade.

TABLE 21.26-B1

MORTAR PROPERTY REQUIREMENTS

Mortar Type	Compressive Strength	Water Retention Min. (%)	Air Content Max. (%)
	Min. (psf)		
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 corbeled 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 corbeled 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 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 just 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 ^{1,3}	No Story Above	One Story Above	Two Stories Above	No. of 1/2" or Equivalent Reinforcing Bars ²
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

¹ Long leg of the angle shall be placed in a vertical position.

² 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.

³ 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 corbeled 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, a 30-pound asphalt-saturated felt or corrosion-resistant metal base 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 wood sheathing under the building paper or water-resistant sheathing.

4. Weepholes shall be provided at the bottom masonry course at intervals of approximately 4 feet.

(b) *Veneer over masonry back-up*. A 30-pound asphalt-saturated felt or corrosion-resistant metal base flashing at the bottom of the veneer shall extend over the top of the foundation and up at least 6 inches and be embedded in the back-up course. Weepholes, at approximately every 3 feet, shall be provided.

(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 3/8-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 ¼-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 2-½ 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 (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 ½-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 4-½ 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 ¹ (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

¹ Bolts and anchors shall be solidly embedded in mortar or grout.

(12) **JOINTS.** (a) The maximum thickness of a mortar joint shall be ½ 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.

(14) **DAMP-PROOFING.** Masonry foundation walls of basements in clay-type soils shall be made damp-proof by the application to the exterior surfaces of a continuous coat of at least ¾-inch thick portland cement and sand coat mortar, or a type M mortar troweled smooth. Surface bonding material, ¼-inch thick, applied to the exterior surfaces, may also be used.

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.

Subchapter VIII — Roof and Ceilings

ILHR 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. ILHR 21.02.

(b) *Slope roof snow loads.* Snow loads specified in s. ILHR 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.* Roofing shall be installed to shed water. Underlayment of 15-pound asphalt-impregnated felt paper or equivalent or other material designated as Class I when tested in accordance with ASTM Standard D 226 shall be provided under shingles. Fasteners shall be corrosion resistant.

(b) *Eave protection for shingles and shakes.* Sheet metal, asphalt-impregnated felt paper or similar eave protection shall be provided on roof slopes of less than 4:12 (18.4°), extending from the edge of the roof a minimum distance of 2 feet 6 inches up the roof slope to a line not less than 12 inches inside the inner face of the exterior wall; except over unheated garages or porches.

(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.

ILHR 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. ILHR 21.02 (3).

(1) **ROOF RAFTERS.** (a) *Ridge boards.* Where rafters meet to form a ridge, the rafters shall be placed directly opposite and secured to each other or to a ridge board a minimum of one inch, nominal, in thickness. Where rafters are offset more than the thickness of the rafter, a ridge board 2 inches, nominal, in thickness shall be used.

(b) *Bearing.* The required bearing for wood rafters shall be in accordance with the National Design Specification for Wood Construction published by National Forest Products Association. In no case shall the bearing be less than 1-1/2 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. ILHR 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.** Notching and boring of beams or girders is prohibited unless determined through structural analysis. Notching and boring of ceiling joists shall comply with pars. (a) and (b).

(a) *Notching.* 1. Notches located in the top or bottom of ceiling 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, and shall not be located in the middle third of the span of the joist.

2. Where ceiling joists are notched on the ends, the notch shall not exceed $1/4$ the depth of the joist. Notches over supports shall be permitted to extend the full bearing length of the support.

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

(b) *Boring.* Holes bored in ceiling joists shall be located no closer than 2 inches to the top or bottom edges of the joist. Where holes are located outside the middle $1/3$ of the span, the diameter of the hole shall not exceed one third the depth of the joist. Where the joist is notched, the hole shall not be closer than 2 inches to the notch.

(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^{1,2,3}

Panel Span Rating	Plywood Thickness (inches)	Maximum Span (inches)		Load (in pounds per square foot)	
		Edges Blocked	Edges Unblocked	Total Load	Live ⁴ 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

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

² 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.

³ 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.

⁴ 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.

Subchapter IX — Fireplace Requirements

ILHR 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

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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 ¼-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. ILHR 23.06 in which a draft diverter or draft regulator is located.

(6) **HEARTH AND HEARTH EXTENSION.** Masonry fireplaces shall have hearth extensions of brick, concrete, stone, tile or other approved noncombustible material properly supported and with no combustible material against the underside of the hearth extension. There shall be a minimum of 4 inches of reinforced concrete under the hearth and hearth extension surface. Wooden forms or centers used during the construction of the hearths and hearth extensions shall be removed when the construction is completed. The minimum dimension of the hearth extension shall be based on the size of the fireplace opening as specified in 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.** Masonry chimneys shall be provided with fireclay flue liners of at least ¾-inch thickness, vitrified clay sewer pipe or material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1800°F. Flue liners shall start at the top of the fire-Register, March, 1992, No. 435

place throat and extend to a point at least 4 inches above the top of the enclosing masonry walls. The nominal thickness of the masonry chimney wall shall be at least 4 inches. Flue liners shall be laid in a full mortar bed and each individual flue shall be wrapped and laterally supported by at least 4 inches of masonry. Firebrick material may be used in lieu of flue liners in the throat of the fireplace.

(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 $\frac{1}{4}$ -inch for each inch distance from the opening.

(12) **CHIMNEY CAPS.** Chimneys shall be provided with chimney caps. Precast or cast-in-place concrete caps shall have a minimum thickness of 2 inches. A minimum of a $\frac{1}{4}$ -inch mortar joint shall be used between flues and caps and shall be caulked or sealed.

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

(14) **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.

ILHR 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 manufac-

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turer's standard gauge (0.024 inch) or $\frac{3}{8}$ -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 fireclay flue lining at least $\frac{3}{8}$ -inch thick, vitrified clay, sewer pipe or with material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1800° F. Flue liners shall commence at the chimney footing.

(b) All flue liners shall be laid in a full mortar bed.

(c) Variations in inside and outside dimensions shall not exceed $\frac{1}{4}$ -inch for clay flue liners.

(8) **CHIMNEY CAPS.** Chimneys shall be provided with chimney caps. Precast or cast-in-place concrete caps shall have a minimum thickness of 2 inches. A minimum of a $\frac{1}{4}$ -inch mortar joint shall be used between flues and caps and shall be caulked or sealed.

(9) **CLEARANCE TO COMBUSTIBLES.** (a) The minimum clearance between masonry chimneys and combustible materials shall be 2 inches for interior chimneys and $\frac{1}{2}$ inch for chimneys located at the exterior wall.

(b) The clearance between the masonry chimney and combustible flooring and trim shall be at least $\frac{1}{2}$ inch.

(c) Ends of wood girders may be supported on a corbeled shelf of a masonry chimney provided there is at least 8 inches of solid masonry between the ends of the girder and the flue liner.

(d) Combustible lath, combustible furring or combustible plaster grounds shall not be placed closer than 1- $\frac{1}{2}$ inches from the masonry. This requirement shall not:

1. Prevent plastering directly on the masonry or on metal lath or on metal furring or

2. Prevent attaching combustible furring and sheathing to the masonry exterior.

(e) All spaces between the masonry and the framing shall be draft stopped.

History: Cr. Register, February, 1985, No. 350, eff. 3-1-85; am. (8), Register, March, 1992, No. 435, eff. 4-1-92.

ILHR 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.

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(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. ILHR 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.