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

Column Spacing	One Floor Only		Roof/Ceiling and One Floor				Roof/Ceiling+ One Floor/Ceiling + One Floor			
	Wood Beams[1] (in., nominal)	A 36 Steel Beams[2]	Wood Beams[1,3] (in., nominal)		A 36 Steel Beams[2]		Wood Beams[1,3] (in., nominal)		A 36 Steel Beams[2]	
			Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone2	Zone 1
24 ft. wide house:										
8 ft.	8x8	—	8x10	10x10	—	—	8x12	10x12	—	—
			6x12	6x12	—	—	6x14	8x14	—	—
10 ft.	8x10	—	8x12	10x12	M 10x9	M 10x9	10x14	10x14	M 12x11.8	M 12x11.8
			6x14	8x14	W 6x12	W 8x10	8x16	8x16	W8x15	W 8x15
12 ft.	8x12	—	12x12	10x14	W 12x10	M 12x11.8	14x14	14x14	W 12x16	W 12x16
			10x14	8x16	W 10x11.5	W 8x15	10x16	12x16	W10x17	W 8x21
15 ft.	12x12	—	—	—	W 12x16	W 12x16	—	—	W 12x22	W 14x22
			—	—	W 10x17	W 6x25	—	—	W 8x28	W 8x31
26 ft. wide house:										
8 ft.	6x10	—	10x10	10x10	—	—	10x12	10x12	—	—
			6x12	8x12	—	—	8x14	8x14	—	—
10 ft.	10x10	—	10x12	10x12	M 10x9	M 12x10	10x14	12x14	M 12x11.8	W 12x14
			8x14	8x14	W 8x10	W 8x13	8x16	8x16	W 8x15	W 8x17
12 ft.	8x12	—	10x14	10x14	M 12x11.8	M 12x11.8	14x14	12x16	W 12x16	W 10x19
			8x16	8x16	W 8x15	W 6x20	12x16	10x18	W 8x21	W 8x24
15 ft.	10x14	—	—	—	W 12x16	W 10x19	—	—	W 14x22	W 14x22
			—	—	W 8x21	W 8x24	—	—	W 8x31	W 8x35
28 ft. wide house:										
8 ft.	6x10	—	10x10	8x12	—	—	10x12	10x12	—	—
			8x12	4x16	—	—	8x14	8x14	—	—
10 ft.	10x10	M 10x7.5	10x12	12x12	M 12x10	W 10x12	12x14	12x14	W 12x14	W 12x14
		W 6x9	8x14	8x14	W 8x13	W 8x13	8x16	10x16	W 8x17	W 10x15
12 ft.	10x12	M 10x9	10x14	12x14	M 12x11.8	W 12x14	12x16	12x16	W 10x19	M 14x18
		W 6x12	8x16	10x16	W 8x15	W 8x18	10x18	10x18	W 8x24	W 8x24
15 ft.	10x14	M 12x10	—	—	W 10x19	M 14x18	—	—	W 14x22	W 14x26
		W 8x13	—	—	W 8x24	W 8x24	—	—	W 8x35	W 8x35
30 ft. wide house:										
8 ft.	8x10	—	10x10	8x12	—	—	10x12	12x12	—	—
			8x12	6x14	—	—	8x14	8x14	—	—
10 ft.	10x10	M 10x7.5	10x12	12x12	M 12x10	M 12x10	12x14	12x14	W 12x14	W 12x14
		W 6x9	8x14	10x14	W 8x13	W 8x13	10x16	10x16	W 10x15	W 10x15
12 ft.	10x12	M 10x9	12x14	12x14	W 12x14	W 12x14	12x16	14x16	M 14x18	M 14x18
		W 6x12	8x16	10x16	W 8x18	W 8x18	10x18	12x18	W 8x24	W 8x24
15 ft.	12x14	M 12x11.8	—	—	M 14x18	W 10x21	—	—	W 14x26	W 14x26
		W 8x15	—	—	W 8x24	W 8x28	—	—	W 8x35	W 10x33
32 ft. wide house:										
8 ft.	8x10	—	8x12	8x12	—	—	12x12	12x12	—	—
			6x14	6x14	—	—	8x14	10x14	—	—
10 ft.	10x10	M 10x7.5	12x12	12x12	W 10x12	W 10x12	12x14	14x14	W 12x14	W 12x16
		W 6x9	8x14	10x14	W 8x13	W 6x16	10x16	10x16	W 10x15	W 10x17
12 ft.	10x12	M 10x9	12x14	14x14	W 12x14	W 12x14	14x16	14x16	M 14x18	W 12x22
		W 6x12	10x16	10x16	W 10x15	W 10x17	12x18	12x18	W 8x24	W 8x28
15 ft.	12x14	M 12x11.8	—	—	M 14x18	W 12x22	—	—	W 14x26	W 14x26
		W 8x15	—	—	W 8x24	W 8x28	—	—	W 10x33	W 10x33

[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

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

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

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	Zone2	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	Zone2	Zone 1	Zone 2	Zone 1
24	1.5	1.5	3	2.5	4	3	5	4	6	5
26	1.5	1.5	2.5	2.5	3	3	4	4	5	5
28	1.5	1.5	2.5	2.5	3	3	4	4	5	5
30	1.5	1.5	2.5	2.5	3	3	4	4	5	5
32	1.5	1.5	2.5	2	3	3	4	4	5	5

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

TABLE 21.25–E

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.

TABLE 21.25–F

COLUMNS–ALLOWABLE LOADS (STEEL*)

Column Diameter (inches)	Wall Thickness (inches)	Weight/ft (Pounds)	Height (feet)	Allowable Load (Pounds)
3	0.216	7.58	8	34,000
			10	28,000
			12	22,000
3.5	0.226	9.11	8	44,000
			10	38,000
			12	32,000
4	0.237	10.79	8	54,000
			10	49,000
			12	43,000
5	0.258	14.62	8	78,000
			10	73,000
			12	68,000
6	0.280	18.97	8	106,000
			10	101,000
			12	95,000

* Fy=36,000 psi

COLUMNS–ALLOWABLE LOADS (WOOD)

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

Note 1: E=1,000,000 psi, F_b=1,000

Note 2: Manufactured columns shall be installed in accordance with their listing and recommended allowable loads.

Note 3: Columns shall be attached to their supports in a manner acceptable to the department.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; cr. (1) (d) and am. (3) (b), Register, February, 1985, No. 350, eff. 3–1–85; r. and recr. (3) (b), am. Table 21.25 B and E, Register, January, 1989, No. 397, eff. 2–1–89; am. (3) (a) and (6), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (1) (c), am. Table 21.25–D, cr. Table 21.25–F, Register, November, 1995, No. 479, eff. 12–1–95.

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

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

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

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

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

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

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

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

(c) *Mixing.* Mortar shall be mixed for at least 3 minutes after all ingredients have been added with the maximum amount of water to produce a workable consistency. Mortars that have stiffened due to water evaporation shall be retempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within $2^1/_2$ 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 PROPORTION[1]

Mortar Type, ASTM C 270	Parts by Volume			
	Portland Cement	Masonry Cement	Hydrated Lime	Sand, Damp Loose Volume
M	1	—	$^1/_4$	
	1	1 (Type II)	—	Not less than $2^1/_4$
S	1	—	$^1/_4$ to $^1/_2$	and not more than 3
	$^1/_2$	1 (Type II)	—	times the sum of
N[2]	1	—	$^1/_2$ to $1^1/_4$	the volumes of the
	—	1 (Type II)	—	cements and lime.

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

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

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

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

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

(5) CAVITY WALL. (a) *Corbeling.* Cavity wall construction may be supported on an 8–inch foundation wall provided the 8–inch wall is 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 formed by openings such as lintels over doors and windows and the back-

sides of chimneys so as to drain any water outward. Open vertical joints or weep holes of $^3/_8$–inch minimum diameter shall be provided in the facing directly above the flashing at a horizontal spacing not exceeding 3 feet.

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

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

TABLE 21.26–C

ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER

Size of Steel Angle[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, corrosion resistant metal or other water–resistant flashing shall extend over the top of the foundation wall from the outside face of the wall and shall extend at least 6 inches up on the sheathing. The flashing shall be installed to drain any water outward.

4. Weep holes shall be provided at the bottom masonry course at maximum intervals of 3 feet.

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

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

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

1. Conventional size veneer (one square foot or less) shall be securely attached to its backing by anchors the equivalent of No. 22 U.S. gauge corrugated sheet steel $^7/_8$–inch wide with at least one such tie located in every 2 square feet of wall. Ties shall be embedded 2 inches in a masonry joint and nailed to the framing with an 8d nail.

2. Large size veneer (greater than one square foot) shall be securely attached with anchors the equivalent of not less than $^1/_4$–inch diameter bolts in accordance with either of the following:

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

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

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

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

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

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

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

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

(b) *Continuous loads.* Joists, trusses and beams other than wood, spaced 4 feet or less on center and 40 feet or less in length, slabs or other members causing continuous loads shall be transmitted to masonry with a minimum bearing of 3 inches upon solid masonry at least 2$^1/_2$ inches in height, or as indicated for concentrated loads.

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

(d) *Support of wood floor members.* Where a wood structural member is buried in masonry for support, it shall be firecut or a self–releasing device shall be used. Where the end of a wood structural member is built into an exterior wall, a $^1/_2$–inch air space shall be provided at the sides, top and end of such member.

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

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

(b) *Multi–wythe walls.* Adjacent wythes shall be bonded with continuous tie assemblies spaced at vertical intervals not exceeding 16 inches; or individual ties of at least $^3/_{16}$–inch diameter for each 4$^1/_2$ square feet of wall area, spaced at a maximum vertical distance of 18 inches and a maximum horizontal distance of 36 inches; or bonded with a full course of masonry headers every seventh course. The clear distance between bond courses shall not exceed 16 inches for solid masonry units and 24 inches for hollow masonry units. Hollow walls shall not be bonded with headers.

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

TABLE 21.26

ALLOWABLE SHEAR ON BOLTS AND ANCHORS

Bolt or Anchor Diameter (inches)	Embedment[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 1/2 inch.

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

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

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

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

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: $Cs = 1 - \frac{(a-30)}{40}$ where a is the slope of the roof expressed in degrees.

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

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

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

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

(a) *Roofing.* 1. 'General'. Underlayment consisting of 15–pound asphalt–impregnated felt paper or equivalent or other Class I material tested in accordance with ASTM D 226 shall be provided under shingles. Fasteners shall be corrosion resistant.

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

Note 2: See appendix for further explanatory material.

2. 'Asphalt shingles'.

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

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

c. Shingles that have a self–sealing adhesive strip shall include a sealant which has a bond strength of at least 1.5 pounds per 3.5 inches of shingle width, at 32° F.

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

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

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

(b) *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; r. and recr. (3) (a), Register, November, 1995, No. 479, eff. 12–1–95.

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 American Forest & Paper 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 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.

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

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

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

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

TABLE 21.28–A

ALLOWABLE LOADS AND SPANS FOR PLYWOOD ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1,2,3]

		Maximum Span (Inches)		Load (in pounds per square foot)	
Panel Span Rating	Plywood Thickness (inches)	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; cr. (6) (c), Register, November, 1995, No. 479, eff. 12–1–95.

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 through the roof and at least 2 feet higher than any portion of the dwelling within 10 feet of the chimney.

(3) FIREBOX MATERIALS. The firebox shall be of the preformed metal type, at least $^1/_4$–inch thick, or listed by a nationally recognized laboratory; or shall be lined with firebrick, at least 2 inches thick and laid in thin joints of refractory cement. The back and sidewalls of the firebox, including the lining, shall be at least 8 inches nominally thick masonry, at least 4 inches of which shall be solid.

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

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

(5m) RETURN AIR GRILLES. Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or in a confined space defined under s. 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 $^5/_8$–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 fireplace 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 $^1/_8$–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 $^1/_4$–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 manufacturer's standard gauge (0.024 inch) or $^5/_8$–inch thick, refractory material. Each chimney shall have an inlet installed at the time of construction.

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

(7) FLUE LINERS. (a) Masonry chimneys shall be lined with fireclay flue lining at least $^5/_8$–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 $^1/_4$–inch for clay flue liners.

(8) CHIMNEY CAPS. Chimneys shall be provided with precast or cast–in–place concrete chimney caps. Chimney caps shall have a minimum thickness of 2 inches, shall slope outwards away from the flue, and shall provide a one–inch overhang and drip edge on all sides. A slip joint shall be installed between the flue and the cap. The slip joint shall be filled with $^1/_4$–inch felt or similar material and shall be caulked with high–temperature caulk or similar material to prevent water infiltration.

(9) CLEARANCE TO COMBUSTIBLES. (a) The minimum clearance between combustibles and masonry chimneys which have any portion located within the exterior wall of the dwelling shall be 2 inches. The minimum clearance between combustibles and masonry chimneys which have all parts completely outside the dwelling, exclusive of soffit or cornice areas, shall be one inch.

(b) Except as required under pars. (c) and (d), the clearance spaces shall remain completely open.

(c) The clearance spaces between chimneys and wood joists, beams, headers or other structural members which form floors or ceilings shall be firestopped with galvanized steel, at least 26 gage thick or with noncombustible sheet material not more than $^1/_2$ inch thick.

(d) Noncombustible material shall be used to prevent entry of debris into the clearance spaces.

History: Cr. Register, February, 1985, No. 350, eff. 3–1–85; am. (8), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (8) and (9); Register, November, 1995, No. 479, eff. 12–1–95.

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.

(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.

Subchapter X – Construction In Floodplains

ILHR 21.33 Construction in floodplains. (1) GENERAL. Where dwelling construction is allowed by local zoning ordinances to take place in floodfringe areas of floodplains, the dwelling shall meet the requirements of this subchapter.

Note: The department of natural resources (DNR) and the federal emergency management agency (FEMA) also have regulations that apply to construction in floodfringe areas.

(2) ELEVATION. (a) *General.* Except as provided in pars. (b) and (c), all dwellings constructed within a floodfringe area shall be elevated so the lowest floor and all basement floor surfaces are located at or above the base flood elevation.

(b) *Certified floodproof basements.* Floodproof basements may have the top of the basement floor no more than 5 feet below the base flood elevation provided the basement is designed by a registered architect or engineer to be watertight and impermeable. No limitation is placed on the use or occupancy of a certified floodproof basement by the provisions of this subchapter.

(c) *Other enclosed spaces.* 1. Enclosed spaces not meeting the requirements of par. (b) are allowed at any depth below the base flood elevation provided the spaces are used only for one or more of the following purposes:

a. Means of egress.

b. Entrance foyers.

c. Stairways.

d. Incidental storage of portable or mobile items.

2. Fully enclosed spaces used only for those purposes listed in subd. 1. shall be designed to automatically equalize the hydrostatic pressure on exterior walls by allowing the entry and exit of floodwaters. Designs for meeting this requirement shall be certified by a registered architect or engineer or shall meet all of the following requirements:

a. There shall be at least two pressure relieving openings and the openings shall have a total net area of not less than one square inch for every square foot of enclosed area subject to flooding.

b. The bottom of all openings shall be no more than 12 inches above grade.

c. Openings may not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

(3) CERTIFICATION OF ELEVATION. A registered land surveyor, architect or engineer shall certify the actual elevation in relation to mean sea level of the lowest structural member required to be elevated by the provisions of this subchapter.

(4) ANCHORAGE. The structural systems of all dwellings shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses at the base flood elevation.

(5) PROTECTION OF ELECTRICAL AND MECHANICAL SYSTEMS. Electrical and mechanical equipment shall be placed above the base flood elevation or shall be designed to prevent water contact with the equipment in case of a flood up to the base flood elevation.

(6) CONSTRUCTION MATERIALS AND METHODS. All dwellings constructed in floodplains shall be constructed using materials and methods designed to minimize flood and water damage.

History: Emerg. cr. eff. 5–8–96; cr. Register, February, 1997, No. 494, eff. 3–1–97.

ILHR 21.34 Construction in coastal floodplains. (1) GENERAL. All dwellings constructed in coastal floodplains shall be designed by a registered architect or engineer and shall meet the requirements of this section and s. ILHR 21.33.

(2) ELEVATION. All dwellings constructed in a coastal floodplain shall be elevated so the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft foundations, pilings, piling caps, columns, grade beams and bracing, is located at or above the base flood elevation.

(3) ENCLOSURES BELOW BASE FLOOD ELEVATION. Enclosures below the base flood elevation in a coastal floodplain may not be used for human occupancy and shall be free of all obstructions, except for non–loadbearing walls and partitions. Non–loadbearing walls and partitions below base flood elevation shall be constructed to break away without causing any structural damage to the elevated portion of the dwelling or foundation system due to the effect of wind loads and water loads acting simultaneously.

(4) FOUNDATIONS. All dwellings located in a coastal floodplain shall be supported and anchored on pilings or columns. The piling or column shall have adequate soil penetration to resist combined water and wind loads at the base flood elevation. Piling or column design shall consider the effect of scour of soil strata. Mat or raft foundations to support columns may not be used where soil under the mat or raft is subject to scour or other erosion from wave flow conditions.

History: Emerg. cr. eff. 5–8–96; cr. Register, February, 1997, No. 494, eff. 3–1–97.

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