

# CHAPTER 45

## HIGH WIND ZONES

This chapter is a *North Carolina* addition and not part of the 2015 *International Residential Code*.  
There will be no underlined text.

### SECTION R4501 GENERAL

**R4501.1 General.** The provisions of this chapter shall be applicable to buildings constructed in high wind zones as noted by the text. These provisions shall be in addition to or in lieu of previous chapters.

**R4501.2 Alternate construction.** In lieu of specific code requirements for structures in the 130, 140, and 150 miles per hour (58 m/s, 63 m/s and 67 m/s) wind zones, compliance with International Code Council ICC 600 *Standard for Residential Construction in High-Wind Regions* or AF&PA *Wood Frame Construction Manual for One- and Two-Family Dwellings* is acceptable.

### SECTION R4502 DESIGN PRESSURE FOR DOORS AND WINDOWS

**TABLE R4502(a)**  
**DESIGN PRESSURES FOR DOORS AND WINDOWS<sup>a, b, c, d</sup>**  
**POSITIVE AND NEGATIVE IN PSF**

VELOCITY (mph)	MEAN ROOF HEIGHT (feet)		
	15	25	35 <sup>e</sup>
130	25	29	32
140	31	35	39
150	37	43	47

For SI: 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s,  
1 degree = 0.01745 rad.

- a. Alternative pressures may be determined by using the *North Carolina Building Code*, ASCE-7, or the *International Building Code*.
- b. If window or door is more than 4 feet from a corner, the pressure from this table shall be permitted to be multiplied by 0.87. This adjustment does not apply to garage doors.
- c. For windows or doors in structures with a roof slope of 10 degrees (2:12) or less from the horizontal, the pressure from this table may be multiplied by 0.90.
- d. Design pressure ratings based on the standards listed in Section R609 are adequate documentation of capacity to resist pressures from the table.
- e. Where the mean roof height exceeds this table, values shall be determined by a design professional.

**TABLE R4502(b)**  
**DESIGN PRESSURES (IN PSF) GARAGE DOORS<sup>a, b, c, d, e</sup>**

VELOCITY (mph)	MEAN ROOF HEIGHT (feet)		
	15	25	35 <sup>f</sup>
130	20	23	26
140	25	29	32
150	30	35	39

For SI: 1 foot = 304.8 mm, 1 mile per hour = 0.447 m/s,  
1 degree = 0.01745 rad.

(continued)

**TABLE R4502(b)—continued**  
**DESIGN PRESSURES (IN PSF) GARAGE DOORS<sup>a, b, c, d, e</sup>**

- a. The pressures in this table are for garage doors at least 9 feet by 7 feet and at least 2 feet from the corner.
- b. Alternative design pressures may be determined by using the *North Carolina Building Code*, ASCE-7, or the *International Building Code*.
- c. For doors in a structure with a roof slope of 10 degrees (2:12) or less from the horizontal the pressures from this table may be multiplied by 0.90.
- d. Design pressure ratings based on tests done according to ASTM E330 are adequate documentation.
- e. Garage doors on the ground level of a structure in a flood zone do not have to meet the above design pressures provided all of the following conditions are met:
  - i. Structure is anchored to the girders and top of the piling to resist the forces given in Chapter 45.
  - ii. The garage door occurs below the top of the piling.
  - iii. Provide openings at the garage level that comply with either of the following options:
    - i. Design all exterior walls at the garage level to break away at 20 psf or less; or
    - ii. Provide openings (in walls at the garage level without the garage level without the garage door) equal to at least 20 percent of the total wall area from the ground to the roof.
- f. Where the mean roof height exceeds this table, values shall be determined by a design professional.

### SECTION R4503 FOOTINGS

**R4503.1 General.** All exterior walls shall be supported on continuous concrete footings in the 140 and 150 mph (63 m/s and 67 m/s) wind zones. Exterior wall footings in the 130 mph (58 m/s) wind zone shall be constructed in accordance with Section R403.1.

**Exception:** Pile foundations shall be constructed in accordance with Chapter 46.

**R4503.1.1 Footing size.** Footings shall be a minimum of 8 inches by 24 inches (203 mm by 610 mm) for houses two and one-half stories and less. The footings for a three-story building shall be 10 inches by 24 inches (254 mm by 610 mm).

**Exception:** Alternative footing sizes are permitted when a footing mass equivalent is provided to resist uplift forces. See Figure R4503.1.1.

**R4503.1.2 Footing reinforcement.** Footings shall be reinforced with three #4 bars or two #5 bars at 3 inches (76 mm) above the bottom of the footing. The bars shall be equally spaced with 3 inches (76 mm) clear minimum from the side of the footing. The bars shall be continuous or lapped 25 inches at all splices.

**R4504.2.1 Exterior foundation walls.** Vertical reinforcement bars shall be installed not more than 2 feet (51 mm) from each corner and at intervals not to exceed Table R4504.2.1 with all reinforced cells grouted solid. The reinforcement bars shall terminate in a bond beam in accordance with Section R4504.2.1.1 or continuous anchorage bolts shall terminate at the sill plate or exterior wall framing in accordance with Section R4504.2.1.2.

**TABLE R4504.2.1  
WALL REINFORCEMENT BARS  
OR CONTINUOUS ANCHORAGE BOLTS<sup>a, b, c, d</sup> *STEEL***

BAR/BOLT SIZE (Inches)	5/8	1/2	3/8
MAXIMUM SPACING (Inches)	96	72	42

For SI: 1 inch = 25.4 mm.

- a. Applies to 140 and 150 mph wind zones.
- b. Continuous anchorage from footing to girder or wall framing.
- c. Applies to footing dowel bars, vertical reinforcement and anchor bolts.
- d. Spacing may exceed the tabulated values by up to 8 inches provided the total number of required bars is installed.

**R4504.2.1.1 Bond beams.** The top of a concrete or masonry foundation wall shall have a bond beam in accordance with Figure R4504.2(a). The bond beam shall be reinforced with one #5 bar. The bar shall be continuous or lapped 25 inches (635 mm) at all splices.

**R4504.2.1.1.1 Bond beam plate anchorage.** A minimum of two 2 x 6 sill plates shall be anchored with 1/2-inch (13 mm) anchor bolts with 2 x 2 x 1/8 inch (51 x 51 x 3 mm) washers at intervals not to exceed Table R4504.2.1.1. An approved anchor from the sill plate to the wall framing shall be installed to resist the forces specified in Table R4508.2 or sheathing shall be fastened in accordance with Figure R4508.4(b). See Figure R4504.2(a).

**TABLE R4504.2.1.1  
ANCHOR BOLT SPACING<sup>a</sup>**

WIND SPEED (mph)	140	150
MAXIMUM SPACING (Inches)	21	18

For SI: 1 inch = 25.4 mm, 1 mile per hour = 0.447 m/s.

- a. Required spacing of 1/2-inch anchor bolts where a bond beam is required and for slab on grade with a single sole plate. See Figure R403.1(1) for 130 mph or less.

**R4504.2.1.2 Continuous anchorage bolts.** A minimum of two 2 x 6 sill plates shall be anchored with continuous anchor bolts in accordance with Table R4504.2.1 with 2 x 2 x 1/8 inch (51 x 51 x 3 mm) washers. Where the vertical anchorage bolts terminate at the sill plate, an approved anchor from the sill plate to the wall framing shall be installed to resist the forces specified in Table R4508.2 or sheathing shall be fastened in accordance with Figure R4508.4(b). See Figure R4504.2(b).

**Exception:** Where the uplift anchorage bolts from Table R4504.2.1 are continuous from the footing to the exterior wall framing, a single 2 x 6 sill plate is permitted. See Figure R4504.2(c).

**R4504.2.2 Exterior concrete slab-on-grade footings.** Anchorage shall be installed at intervals not to exceed Table R4504.2.1 and shall terminate in a minimum 2 x 4 double sole plate. See Figure 4504.2(d).

**Exceptions:**

- 1. Where the bolts terminate in a single sole plate, anchorage shall be installed at intervals not to exceed Table R4504.2.1.1. See Figure R4504.2(e).
- 2. Foundation anchorage spaced and installed in accordance with the manufacturer's installation instructions that provides equivalent anchorage to resist the forces in Table R4508.2 shall be installed to provide continuous load path from the single sole plate to the wall.

**R4504.2.3 Ground supported slab with masonry stem wall.** A minimum of two 2x sill plates shall be anchored with 1/2-inch (13 mm) continuous anchor bolts with 2 x 2 x 1/8 inch (51 x 51 x 3 mm) washers at intervals not to exceed Table R4504.2.1.1. An approved anchor from the sill plate to the wall framing shall be installed to resist the forces specified in Table R4508.2 or sheathing shall be fastened in accordance with Figure R4508.4(b). See Figure R4504.2(f).

**SECTION R4505  
WALL CONSTRUCTION**

**R4505.1 Construction.** Exterior walls of wood frame construction shall be in accordance with Figures R602.3(1) and R602.3(2). Components of exterior walls shall be fastened in accordance with Table R602.3(1). Walls of wood frame construction shall be designed and constructed in accordance with ANSI AWC *National Design Specification for Wood Construction*, listed in Chapter 44.

Exterior walls subject to wind speeds of 130 mph (58 m/s) or greater as established in Table R301.2(1) shall be designed in accordance with accepted engineering practice. See Tables R4505(a) and R4505(b).

In bearing walls, studs which are not more than 10 feet (3048 mm) in length shall be spaced not more than is specified in Tables R4505(a) and R4505(b) for the corresponding stud size.

**SECTION R4506  
STRUCTURAL BRACING**

**R4506.1 Structural bracing in 130 mph wind zone.** Structural bracing in the 130 mph (58 m/s) wind zone shall comply with Section R602.10.3.

**R4506.2 Structural bracing in 140 and 150 mph wind zones.** All stories shall be continuously sheathed with wood structural panels. All panels shall be fastened in accordance with Table R4506.2. Where sheathing is used to resist uplift, see Section R4508.4 for blocking requirements. Otherwise, blocking shall be installed if less than 50 percent of the wall length is sheathed. If a wall is sheathed less than 25 percent of its length, then that wall shall be designed in accordance with approved engineering practice.

**TABLE R4506.2  
PANEL FASTENER SPACING<sup>a</sup>**

	BLOCKING REQUIRED	NO BLOCKING REQUIRED
Center of Panel	6"	12"
Vertical Edge of Panel	6"	6"
Horizontal Edge of Panel	3"	3"

For SI: 1 inch = 25.4 mm.

a. Table based on 8d nails.

**R4506.3 Gable endwalls.** Gable endwalls in the 130, 140 and 150 mph (58 m/s, 63 m/s and 67 m/s) wind zones shall either be supported by lateral bracing at the ceiling or have continuous studs from the floor to the roof. 2 × 4 studs at 16 inches (406 mm) on center are limited to 10 feet (3048 mm) in length between supports. Nonbearing 2 × 6 SPF #2 studs at 16 inches (406 mm) on center with  $\frac{3}{8}$ -inch (9 mm) wood structural panel sheathing are limited to unsupported lengths of 18 feet (5486 mm) in 130 mph (58 m/s), 16 feet (4877 mm) in 140 mph (53 m/s) and 14 feet (4267 mm) in 150 mph (67 m/s) wind zones. Where open web trusses are installed, wood structural panel sheathing shall extend 12 inches (305 mm) beyond horizontal construction joints. Where the horizontal joint occurs over minimum 1 inch (25 mm) thick OSB or plywood or 2× rimboard, a minimum 1½ inch (38 mm) overlap is required.

**R4506.4 Lateral support at ceiling.** Where studs are not continuous, the ceiling must be used to support the endwall. 2 × 4 lateral bracing shall be installed on the top of ceiling joists or truss bottom chords at 8 feet (2438 mm) on center and extend 8 feet (2438 mm) inward from the gable endwall. See Figure R4506.7(a).

**R4506.5 Full height studs.** Full height studs may be sized using the bracing at the ceiling to limit the stud length. See Figure R4506.5.

**R4506.6 Cathedral endwalls.** Studs shall be continuous from the uppermost floor to either the ceiling or the roof.

**R4506.7 Overhang at endwalls.** The overhang is limited to 12 inches (305 mm) where a laddered soffit is installed. The overhang may be increased to 24 inches (610 mm) where outlookers are framed over a dropped endwall into the first rafter or truss. See Figures R4506.7(a) and R4506.7(b). If the overhang exceeds 24 inches (610 mm), then the overhang shall be designed in accordance with approved engineering practice.

**R4506.8 Roof sheathing attachment.** The roof sheathing panel edges shall be blocked and nailed at the end two rafter or truss spaces. See Figure R4506.8.

**Exception:** The panel edges need not be blocked where 2 × 4 diagonal braces are framed from the top of the endwall to the lateral bracing at the ceiling.

## SECTION R4507 MASONRY WALL CONSTRUCTION

**R4507.1 Reinforcement.** Masonry walls subject to wind speeds of 140 mph (63 m/s) or greater, as established in Table R301.2(1), shall be constructed in accordance with Table R4507.1 or the requirements of Figures R4507.1(a) and R4507.1(b) and this section. Additionally, the minimum area of reinforcement shall not be less than 0.002 times the gross cross-sectional area wall, not more than two-thirds of which may be used in either direction. No required vertical reinforcement shall be less than  $\frac{3}{8}$  inch (9.5 mm) in diameter. Principal wall reinforcement shall have a maximum spacing of 4 feet (1219 mm) on center.

For 130 mph (58 m/s) wind zones, see Figure R606.11(1) and Table R606.6.4.

**TABLE R4507.1  
H/T LATERAL SUPPORT RATIOS FOR  
UNREINFORCED EXTERIOR MASONRY WALLS<sup>a, b, d, e</sup>**

Wall Construction	ULTIMATE WIND SPEED, MPH <sup>c</sup>	
	140	150
Solid masonry units	13	11
Hollow concrete masonry units or masonry bonded hollow walls	9	8
Cavity walls identical wythes	The $H/t$ ratio shall be 0.70 of the $H/t$ ratio for single wythe walls. The $t$ -value shall be the sum of the nominal thickness of the individual wythes.	
Cavity walls with wythes of different types or size masonry	The wall shall be designed based on ACI-530 or the $H/t$ ratio may be 0.70 of the $H/t$ ratio of a single wythe hollow wall. The $t$ -value shall be the sum of the nominal thickness of the individual wythes.	

a.  $H$  = clear height or length between lateral supports.

$t$  = nominal wall thickness.

b. All masonry units shall be laid in Type M, S or N mortar. Where Type N mortar is used and the wall spans in the vertical direction, the ratios shall be reduced by 10 percent.

c. Design based on partially enclosed building.

d. These values are based on using masonry cement mortar. If nonair-entrained Portland cement/lime mortar is used, the values in the table may be increased by 1.25. Larger  $H/t$  ratios may be used if the design is done in accordance with ACI-530.

e. Larger  $H/t$  ratios may be used if the design is done in accordance with ACI-530.

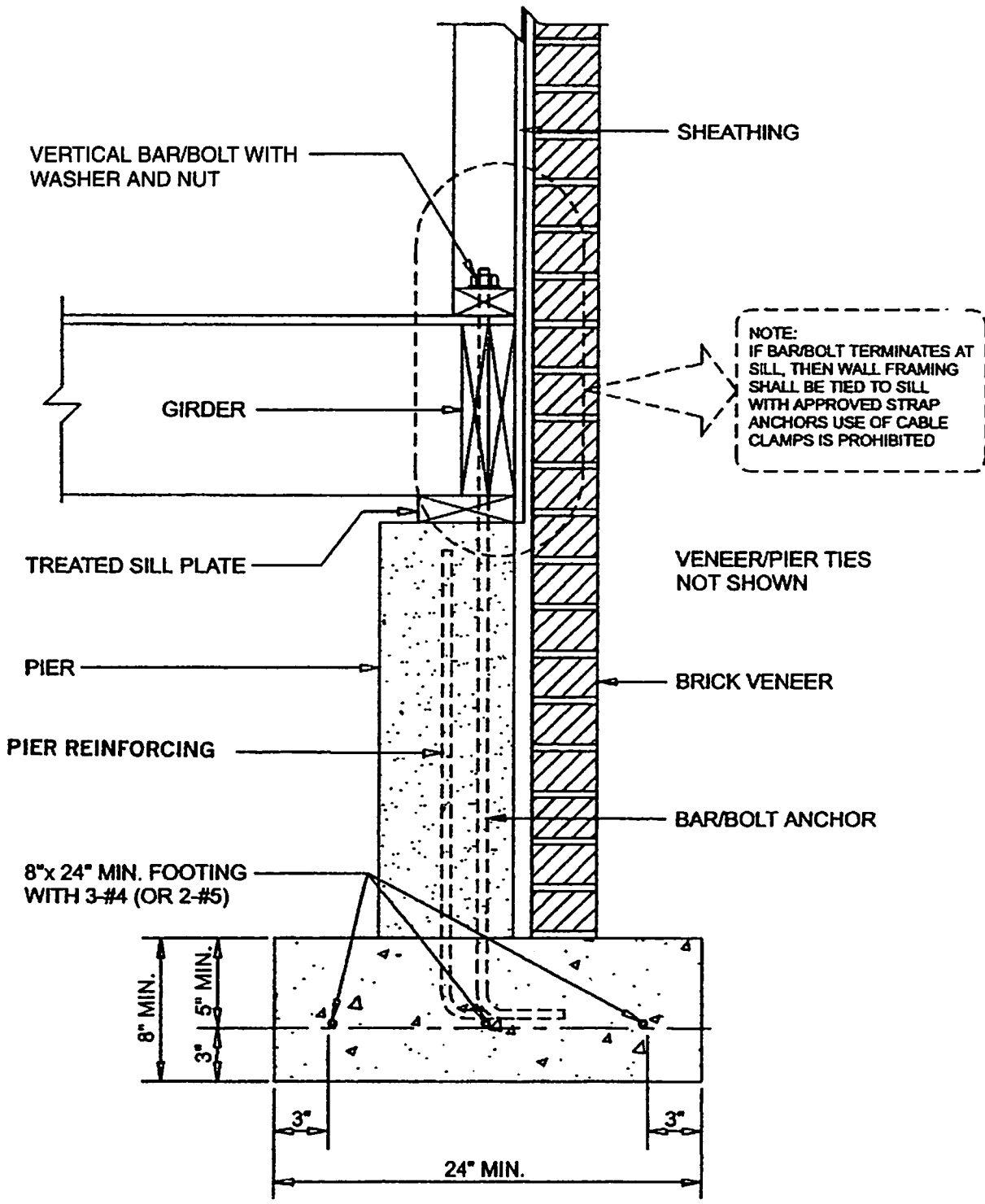


FIGURE R4503.2(a)  
CONTINUOUS VENEER PIER/CURTAIN WALL

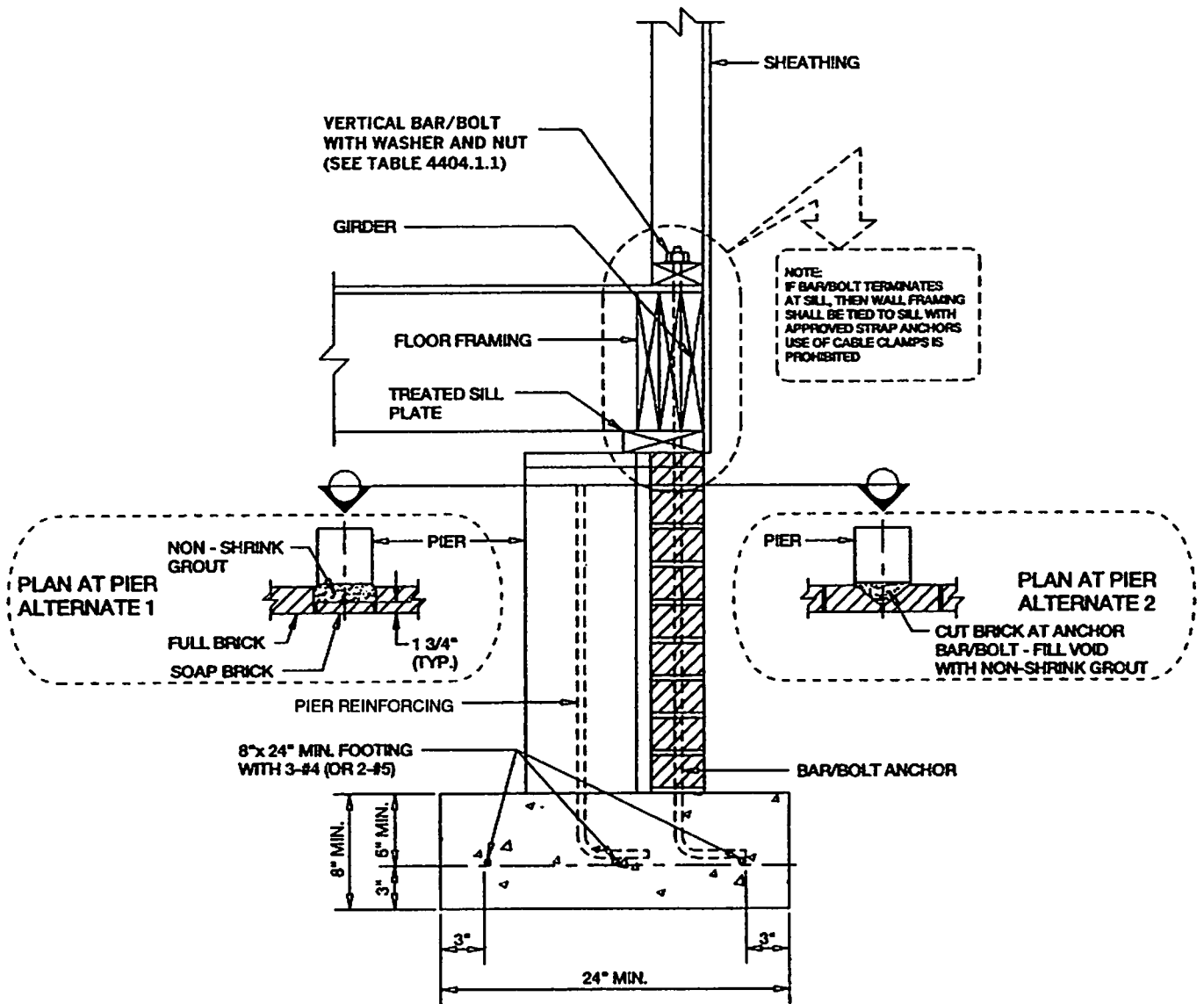
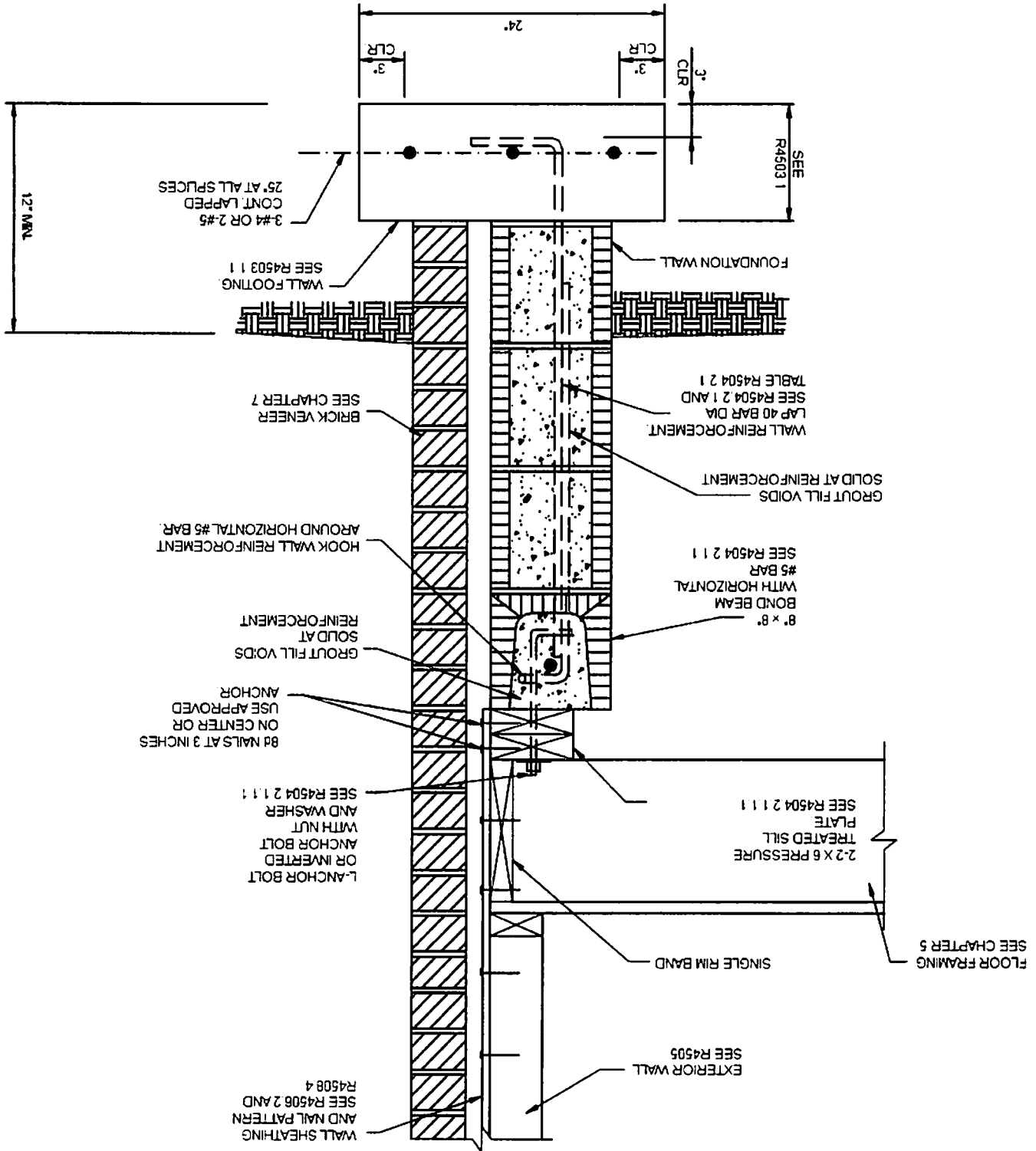
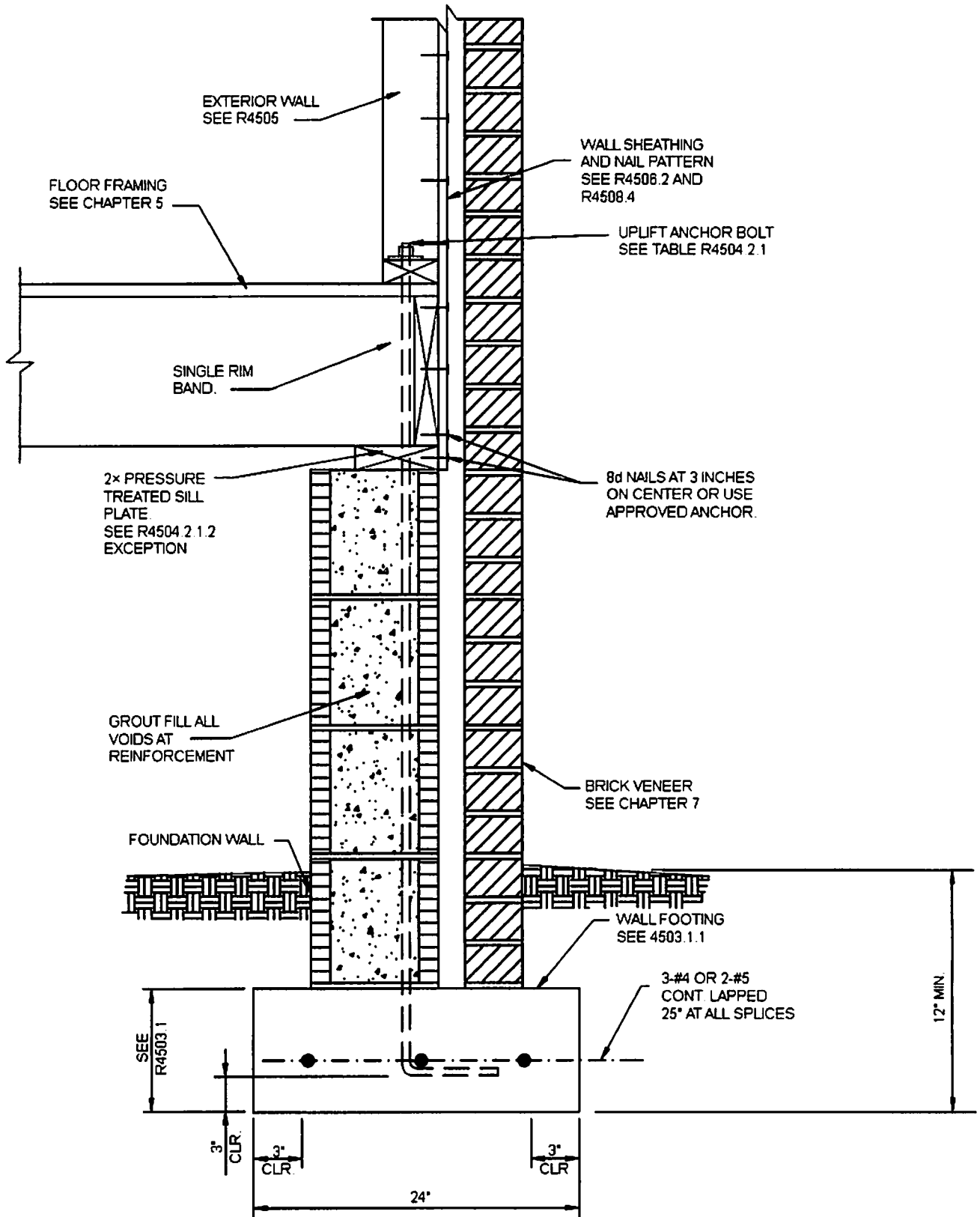


FIGURE R4503.2(c)  
 VENEER SHIRT WALL  
 PIER/CURTAIN WALL

FIGURE R4504.2(a)  
FOUNDATION WALL WITH BOND BEAM





**FIGURE R4504.2(c)**  
**FOUNDATION WALL WITH UPLIFT ANCHOR BOLTS**  
**CONTINUOUS FROM FOOTING TO EXTERIOR WALL FRAMING**

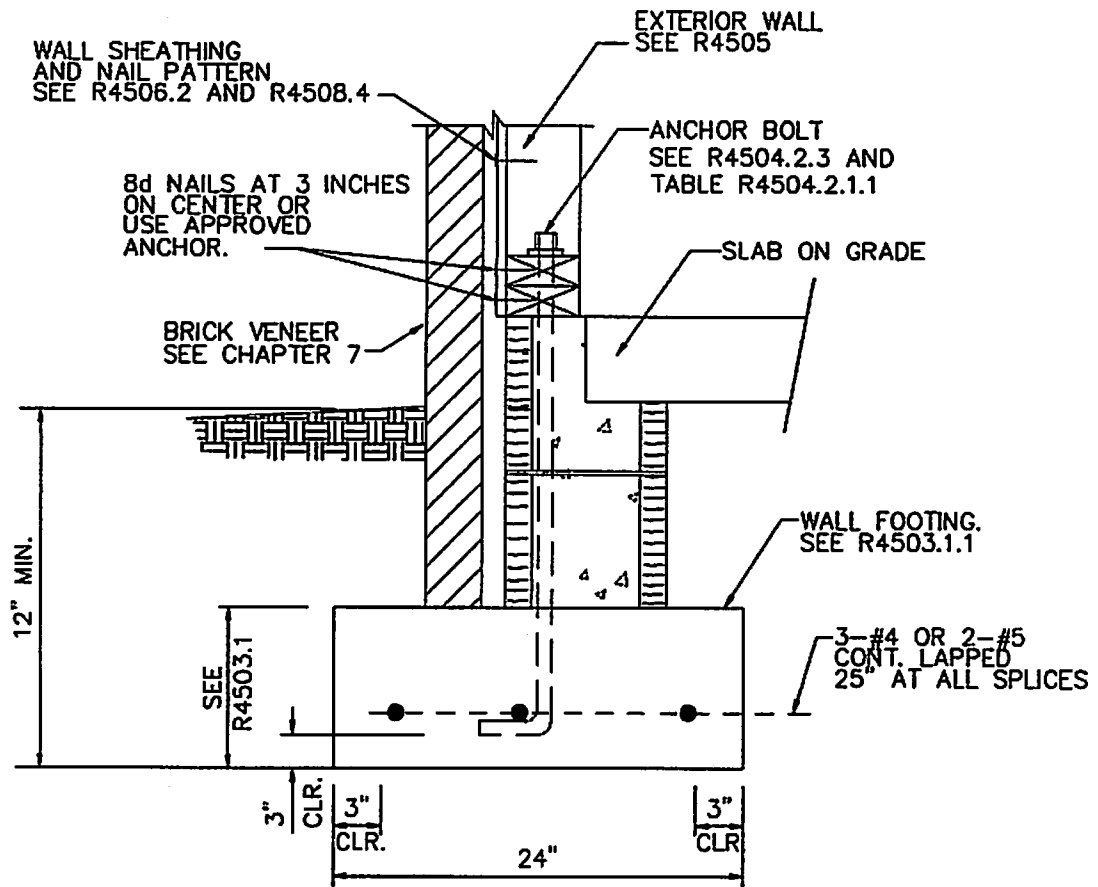
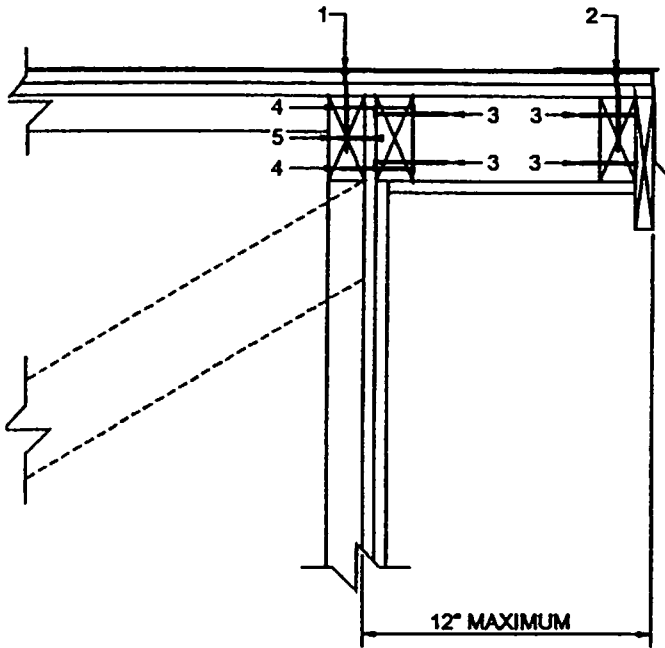
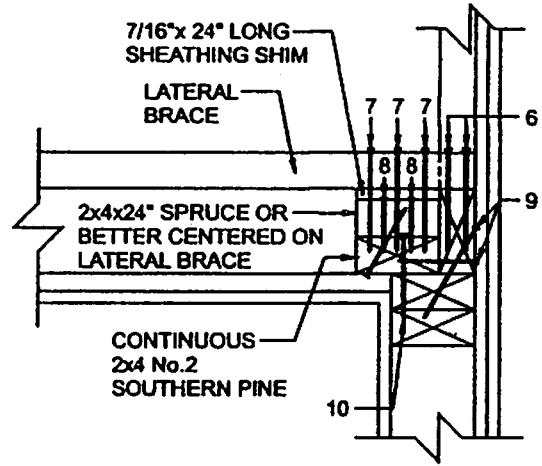


FIGURE R4504.2(f)  
GROUND SUPPORTED SLAB WITH MASONRY STEM WALL





3 R4506.7a "LADDER" ATTACHMENT  
NAILING DETAIL AT TOP OF GABLE

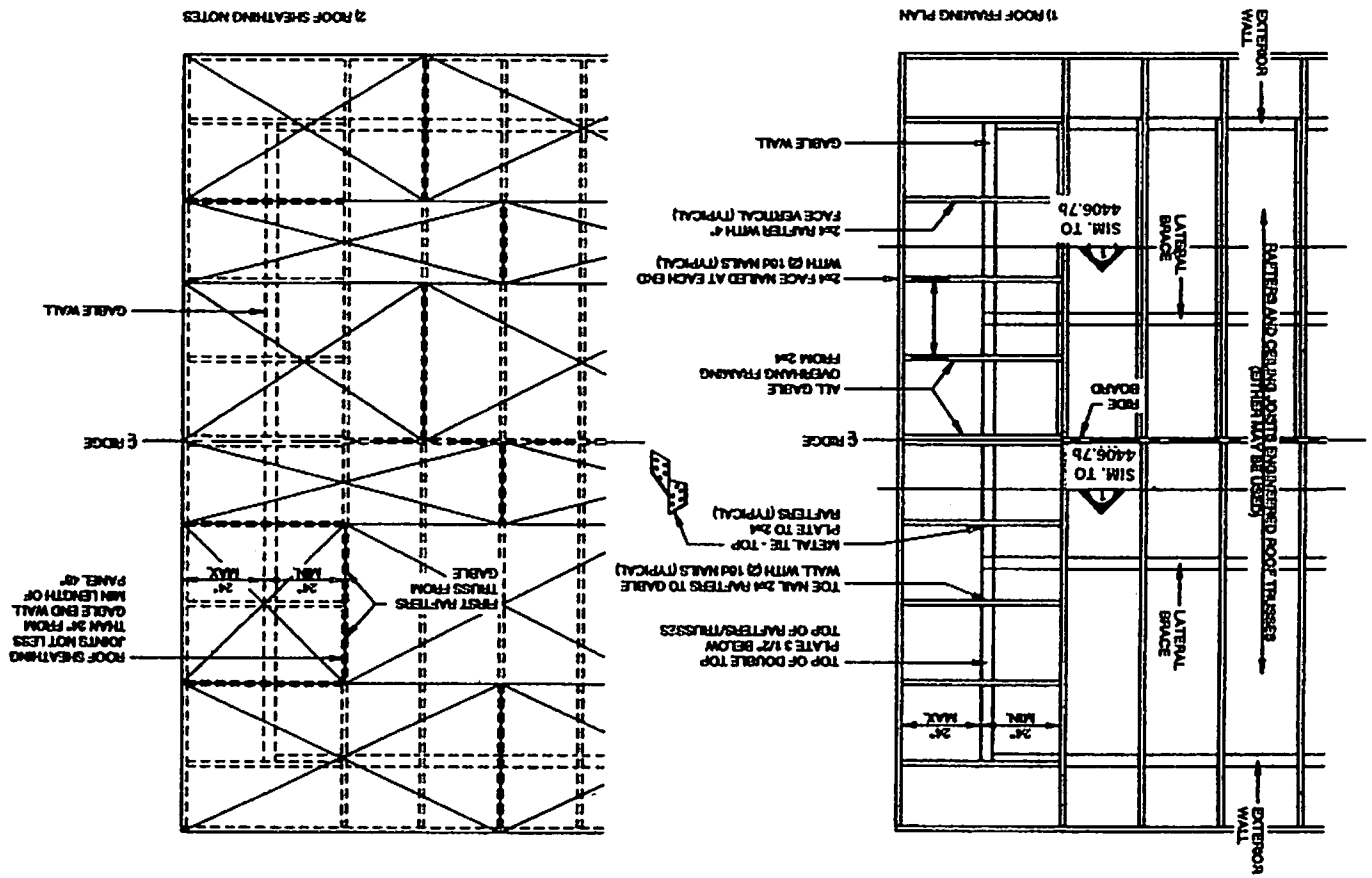


4 R4506.7a  
NAILING DETAIL AT LATERAL BRACE

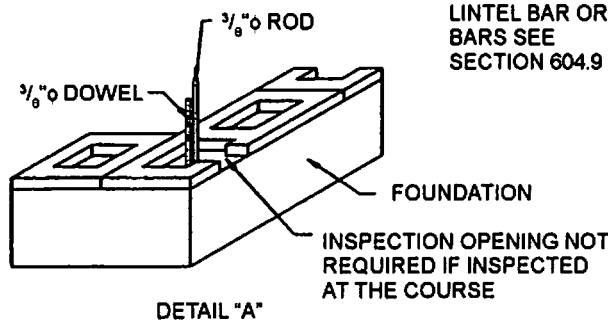
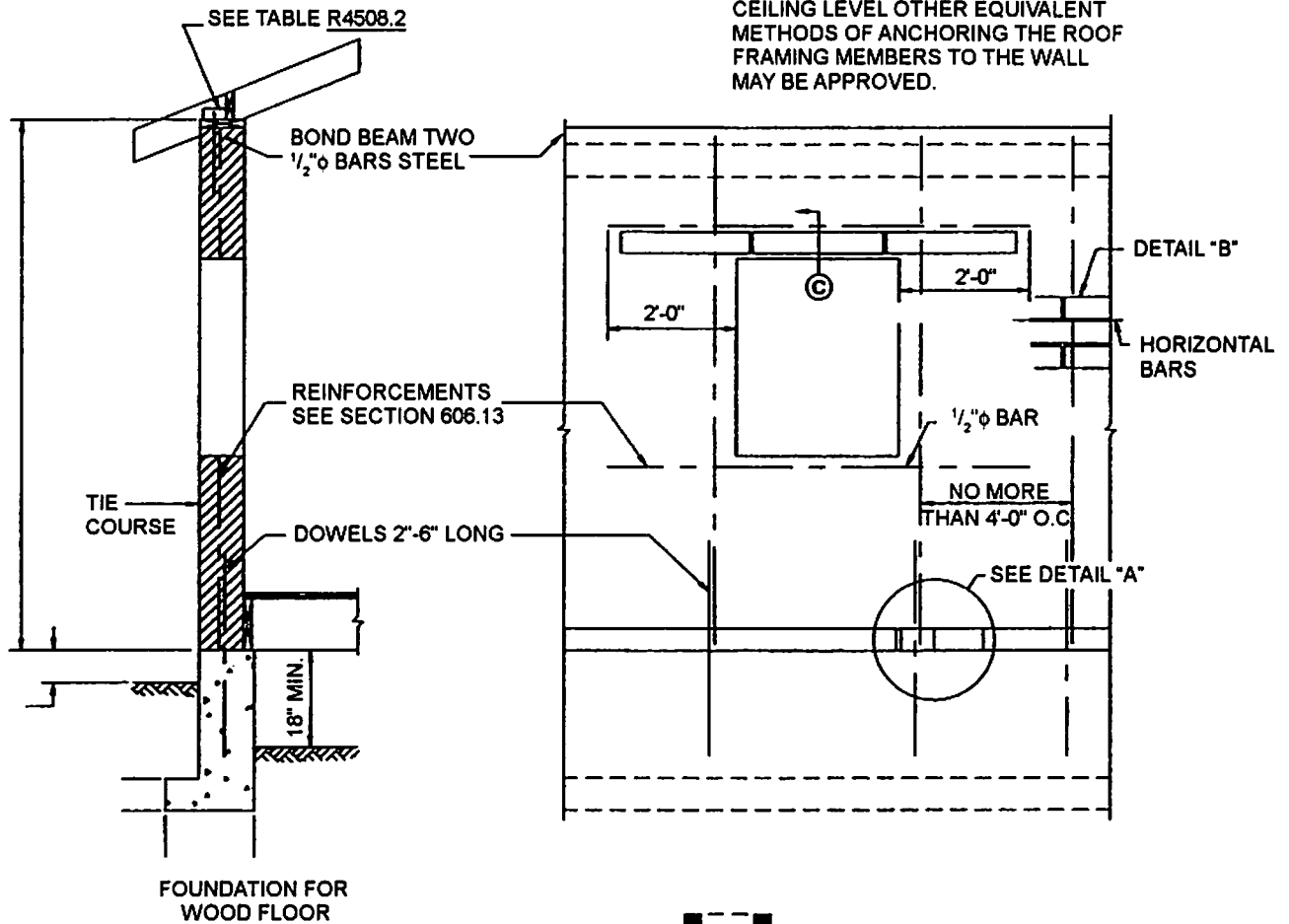
NAIL SCHEDULE			
MARK	No. & SIZE	SPACING	REMARKS
1	8d	4"o.c.	
2	8d	6"o.c.	
3	(2) 16d		EACH SIDE
4	(2) 16d	24"o.c.	
5	8d	6"o.c.	
6	(2) 16d		EACH TRUSS
7	(5) 16d		TYPICAL
8	(6) 16d (* TO 2x4 BELOW)		ALTERNATE: (8) 8d
9	16d	8"o.c.	ALTERNATE TOENAIL & ENDNAIL
10	16d	8"o.c.	

FIGURE R4506.7a—continued  
OVERHANG AT ENDWALLS

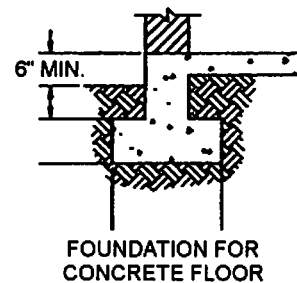
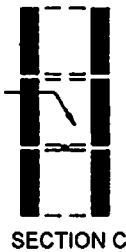
FIGURE R4506.7(c)  
GABLE END OVERHANG



NOTE: CONTINUOUS BOND REQUIRED AT EACH FLOOR OR BEAM CEILING LEVEL OTHER EQUIVALENT METHODS OF ANCHORING THE ROOF FRAMING MEMBERS TO THE WALL MAY BE APPROVED.

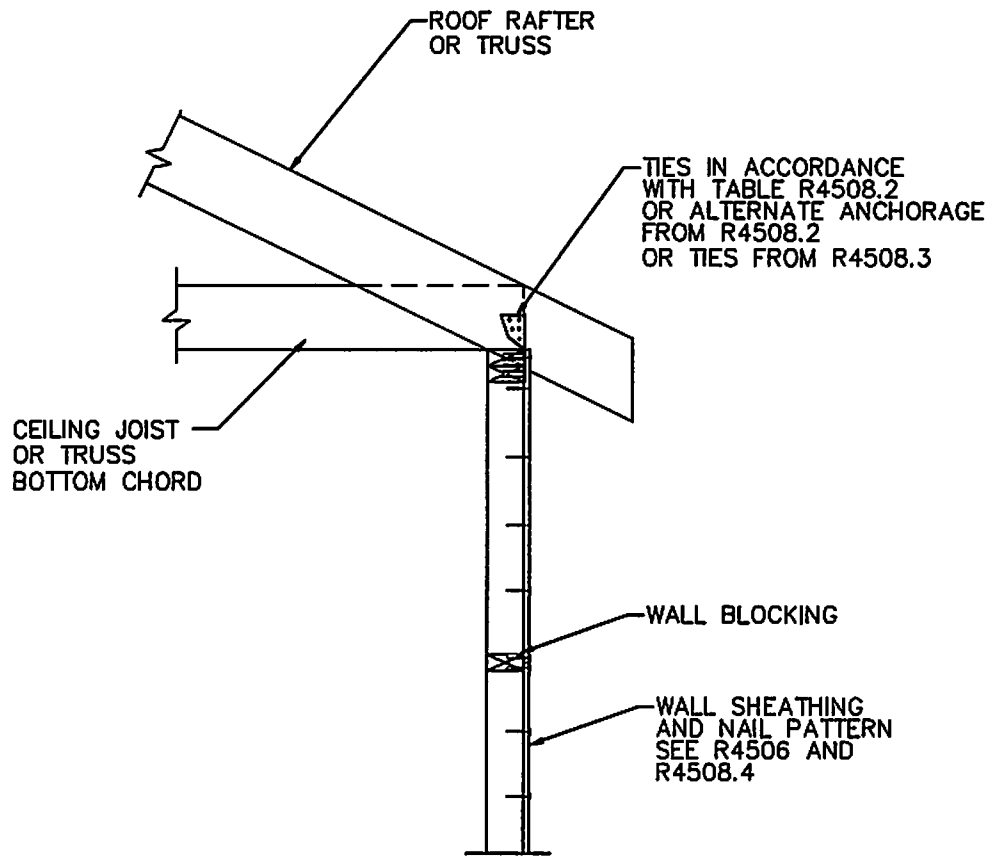


LINTEL BAR OR BARS SEE SECTION 604.9



A FULL BED JOINT MUST BE PROVIDED. ALL CELLS CONTAINING VERTICAL BARS ARE TO BE FILLED TO TOP OF WALL PROVIDE INSPECTION OPENING AS SHOWN ON DETAIL "A". HORIZONTAL BARS ARE TO BE LAID AS SHOWN ON DETAIL "B". LINTEL BARS ARE TO BE LAID AS SHOWN ON SECTION "C".

FIGURE R4507.1(a)  
 REQUIREMENTS FOR REINFORCED GROUTED MASONRY CONSTRUCTION  
 WHERE WIND ZONES ARE 140 MPH OR GREATER



**FIGURE R4508.3**  
**ROOF RAFTER/TRUSS ANCHORAGE**

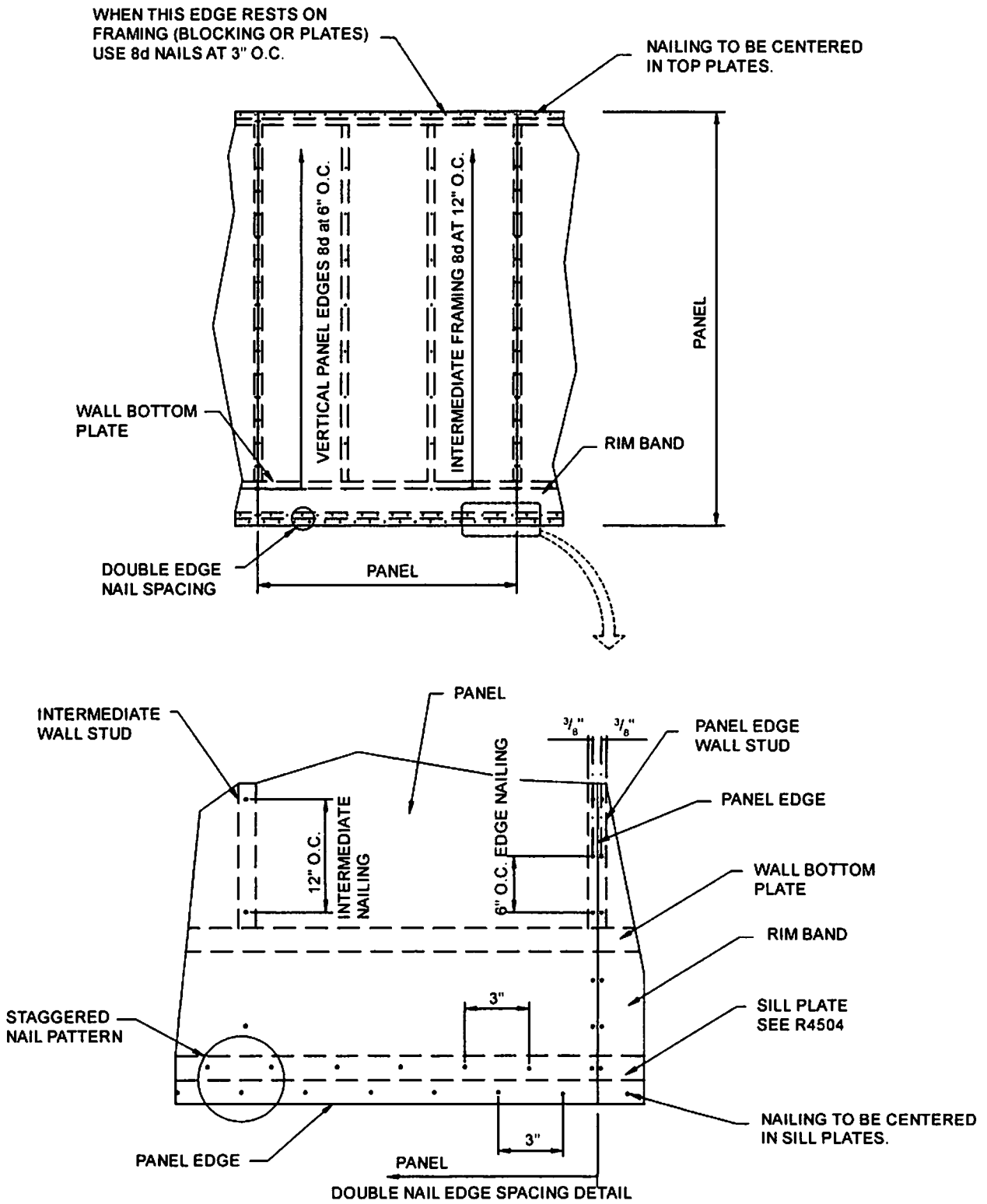


FIGURE R4508.4(b)  
 PANEL ATTACHMENT TO COUNTER UPLIFT HORIZONTAL OR VERTICAL