7.4.3 Anchorage and Bearing on Foundation Walls

Anchorage Tension (Uplift) Capacity

The equations below determine whether the concrete or masonry shear area of each bolt is sufficient to resist pull-out from the wall as a result of uplift forces and shear friction in the concrete.

[ACI-318•11.3, ACI-530•2.1.2]

Concrete Foundation Wall

$$V_u \leq \phi V_c$$

$$V_c = 4A_v\sqrt{f'_c}$$

$$A_v = \text{minimum of} \begin{Bmatrix} \pi l_b^{\,2} \\ \pi h^2 \end{Bmatrix}$$

Masonry Foundation Wall

$$b_a \leq B_a$$

$$B_a = \text{minimum of} \begin{Bmatrix} 0.5A_p\sqrt{f'_m} \\ 0.2A_b f_y \end{Bmatrix}$$

$$A_p = \text{minimum of} \begin{Bmatrix} \pi l_b^{\,2} \\ \pi l_{be}^{\,2} \end{Bmatrix}$$

Bearing Strength

Determining the adequacy of the bearing strength of a foundation wall follows ACI-318•10.17 for concrete or ACI-530•2.1.7 for masonry. The bearing strength of the foundation wall is typically adequate for the loads encountered in residential construction.

[ACI-318•10.17 and ACI-530•2.1.7]

Concrete Foundation Wall

B_c = factored bearing load

$$B_c \leq \phi 0.85 f'_c A_1$$

$$\phi = 0.7$$

Masonry Foundation Wall

$$f_a \leq F_a$$

$$f_a = \frac{P}{A_1}$$

$$F_a \leq 0.25 f'_m$$

When the foundation wall's supporting surface is wider on all sides than the loaded area, the designer is permitted to determine the design bearing strength on the loaded area by using the equations below.

[ACI-318•10.7 and ACI-530•2.1.7]

Concrete Foundation Wall

$$B_c = \phi 0.85 f'_c A_1 \sqrt{\frac{A_2}{A_1}} \quad \text{where} \quad \sqrt{\frac{A_2}{A_1}} \leq 2$$

Masonry Foundation Wall

$$f_a = \frac{P}{A_1\sqrt{A_2/A_1}} \quad \text{where} \quad \sqrt{\frac{A_2}{A_1}} \leq 2$$

7.5 Design Examples

EXAMPLE 7.1 *Roof Sheathing Connections*

Given

- Design wind speed is 130 mph gust with an open (coastal) exposure
- Two-story home with a gable roof
- Roof framing lumber is Southern Yellow Pine (G=0.55)
- Roof framing is spaced at 24 inches on center
- Roof sheathing is 7/16-inch-thick structural wood panel

Find

1. Wind load (suction) on roof sheathing.
2. Nail type/size and maximum spacing.

Solution

1. Determine the wind load on roof sheathing (Chapter 3, Section 3.6.2)

Step 1: Basic velocity pressure	=	24.6 psf	(Table 3.7)
Step 2: Adjust for open exposure	=	1.4(24.6 psf) = 34.4 psf	
Step 3: Skip			
Step 4: Roof sheathing G_{cp}	=	-2.2	(Table 3.9)
Step 5: Design load	=	(-2.2)(34.4 psf) = 76 psf	

2. Select a trial nail type and size, determine withdrawal capacity, and calculated required spacing

Use an 8d pneumatic nail (0.113 inch diameter) with a length of 2 3/8 inches. The unadjusted design withdrawal capacity is determined using the equation in Section 7.3.3.

$$W = 1380(G)^{2.5}DL_p$$

$G = 0.55$
$D = 0.113$ in
$L_p = (2\ 3/8 \text{ in}) – (7/16 \text{ in}) = 1.9$ in

$$W = 1380(0.55)^{2.5}(0.113 \text{ in})(1.9 \text{ in}) = 66.5 \text{ lb}$$

Determine the adjusted design withdrawal capacity using the applicable adjustment factors discussed in Section 7.3.2.

$$W' = WC_D = (66.5 \text{ lb})(1.6) = 106 \text{ lb}$$

Determine the required nail spacing in the roof sheathing panel interior.

Tributary sheathing area	= (roof framing spacing)(nail spacing)
	= (2 ft)(s)
Withdrawal load per nail	= (wind uplift pressure)(2 ft)(s)
	= (76 psf)(2 ft)(s)

$$W' \geq \text{design withdrawal load}$$
$$106 \text{ lb} \geq (76 \text{ psf})(2 \text{ ft})(s)$$
$$s \leq 0.69 \text{ ft}$$

Use a maximum nail spacing of 8 inches in the roof sheathing panel interior.