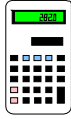


**EXAMPLE 7.10****Concrete Wall to Footing (Shear) Connection****Given**

Maximum transverse shear load on bottom of wall = 1,050 plf (due to soil)  
 Dead load on wall = 1,704 plf  
 Yield strength of reinforcement = 60,000 psi  
 Wall thickness = 8 inches  
 Assume  $\mu = 0.6$  for concrete placed against hardened concrete not intentionally roughened.  
 $f'_c = 3,000$  psi

**Find**

- Whether a dowel or key is required to provide increased shear transfer capacity
- If a dowel or key is required, size accordingly

**Solution**

1. Determine factored shear load on wall due to soil load (i.e., 1.6H per Chapter 3, Table 3.1)

$$V = 1,050 \text{ plf}$$

$$V_u = 1.6 (1,050 \text{ plf}) = 1,680 \text{ plf}$$

2. Check friction resistance between the concrete footing and wall

$$V_{\text{friction}} = \mu N = \mu (\text{dead load per foot of wall})$$

$$= (0.6)(1,704 \text{ plf}) = 1,022 \text{ plf} < V_u = 1,680 \text{ plf}$$

Therefore, a dowel or key is needed to secure the foundation wall to the footing.

3. Determine a required dowel size and spacing (Section 7.2 and ACI-318•5.14)

$$A_{vf} = V_u / (\phi f_y \mu)$$

$$= (1,680 \text{ plf}) / [(0.85)(60,000)(0.6)] = 0.05 \text{ in}^2 \text{ per foot of wall}$$

Try a No. 4 bar ( $A_v = 0.20 \text{ in}^2$ ) and determine the required dowel spacing as follows:

$$A_{vf} = A_v / S$$

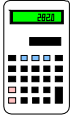
$$0.05 \text{ in}^2 / \text{lf} = (0.2 \text{ in}^2) / S$$

$$S = 48 \text{ inches}$$

**Conclusion**

This example problem demonstrates that for the given conditions a minimum of one No. 4 rebar at 48 inches on center is required to adequately restrict the wall from slipping. Alternatively, a key may be used or the base of the foundation wall may be laterally supported by the basement slab.

It should be noted that the factored shear load due to the soil lateral pressure is compared to the estimated friction resistance in Step 1 without factoring the friction resistance. There is no clear guideline in this matter of designer judgment.

**EXAMPLE 7.11****Concrete Anchor****Given**

- 1/2-inch diameter anchor bolt at 4 feet on center with a 6 inch embedment depth in an 8-inch thick concrete wall
- The bolt is an ASTM A36 bolt with  $f_y = 36$  ksi and the following design properties for ASD; refer to AISC Manual of Steel Construction (AISC,1989):

$$\begin{aligned} F_t &= 19,100 \text{ psi (allowable tensile stress)} \\ F_u &= 58,000 \text{ psi (ultimate tensile stress)} \\ F_v &= 10,000 \text{ psi (allowable shear stress)} \end{aligned}$$

- The specified concrete has  $f'_c = 3,000$  psi
- The nominal design (unfactored) loading conditions are as follows:
 

Shear load	=	116 plf
Uplift load	=	285 plf
Dead load	=	180 plf

**Find**

Determine if the bolt and concrete are adequate for the given conditions.

**Solution**

1. Check shear in bolt using appropriate ASD steel design specifications (AISC, 1989) and the ASD load combinations in Chapter 3.

$$f_v = \frac{\text{shear load}}{\text{bolt area}} = \frac{116 \text{ plf (4 ft)}}{(0.196 \text{ in}^2)} = 2,367 \text{ psi}$$

$$F_v = 10,000 \text{ psi}$$

$$f_v \leq F_v \quad \text{OK}$$

2. Check tension in bolt due to uplift using appropriate ASD steel design specifications (AISC, 1989) and the appropriate ASD load combination in Chapter 3.

$$T = [(285 \text{ plf}) - 0.6 (180 \text{ plf})] (4 \text{ ft}) = 708 \text{ lb}$$

$$f_t = \frac{T}{A_{\text{bolt}}} = \frac{708 \text{ lb}}{0.196 \text{ in}^2} = 3,612 \text{ psi}$$

$$f_t \leq F_t$$

$$3,612 \text{ psi} < 19,100 \text{ psf} \quad \text{OK}$$

3. Check tension in concrete (anchorage capacity of concrete) using ACI-318•11.3 and the appropriate LRFD load combination in Chapter 3. Note that the assumed cone shear failure surface area,  $A_v$ , is approximated as the minimum of  $\pi$  (bolt embedment length)<sup>2</sup> or  $\pi$  (wall thickness)<sup>2</sup>.

$$V_u = T = [1.5 (285 \text{ plf}) - 0.9 (180 \text{ plf})] (4 \text{ ft}) = 1,062 \text{ lb}$$

$$A_v = \text{minimum of } \begin{cases} \pi (6 \text{ in})^2 = 113 \text{ in}^2 \\ \pi (8 \text{ in})^2 = 201 \text{ in}^2 \end{cases}$$

$$\phi V_c = \phi 4 A_v \sqrt{f'_c} = (0.85)(4)(113 \text{ in}^2) \sqrt{3,000 \text{ psi}} = 21,044 \text{ lb}$$

$$V_u \leq \phi V_c$$

$$1,062 \text{ lb} \leq 21,044 \text{ lb} \quad \text{OK}$$