$f_{c,\,max}$ = 163 psi/stud
P = f_cA = (163 psi/stud)(1.5 in)(3.5 in) = 856 lb/stud
$$w = (856\ \text{lb/stud})\left(\frac{1\ \text{stud}}{2\ \text{ft}}\right) = 428\ \text{plf} \quad \text{(uniform dead load at top of wall)}$$

Therefore, the maximum axial (dead) load capacity is 428 plf with the wind load case (i.e., D+W).

7. Determine maximum axial gravity load without bending load

This analysis applies to the D + L+ 0.3(S or L_r) and D + (S or L_r) + 0.3L load combinations (see Table 3.1, Chapter 3).

Using F_c' determined in Step 5 (axial load only case), determine the stud capacity acting as a column with continuous lateral support in the weak-axis buckling direction.

$$F_c \leq F_c'$$
$$\frac{P}{A} \leq 419\ \text{psi}$$
$$P_{max} = (419\ \text{psi})(1.5\ \text{in})(3.5\ \text{in}) = 2{,}200\ \text{lbs/stud}$$

Maximum axial load capacity (without simultaneous bending load) is 2,200 lbs/stud or 1,100 lbs/lf of wall.

8. Check bearing capacity of wall plate

Not a capacity limit state. ($F_{c\perp}$ is based on deformation limit state, not actual bearing capacity.) OK by inspection.

Conclusion

The axial and bending load capacity of the example wall is ample for most residential design conditions. Thus, in most cases, use of the prescriptive stud tables found in residential building codes may save time. Only in very tall walls (i.e., greater than 10 feet) or more heavily loaded walls than typical will a special analysis as shown here be necessary, even in higher-wind conditions. It is likely that the controlling factor will be a serviceability limit state (i.e., wall deflection) rather than strength, as shown in several of the floor design examples. In such cases, the wall system deflection adjustment factors of Table 5.6 should be considered.

Note:

The axial compression capacity determined above is conservative because the actual EI of the wall system is not considered in the determination of C_p for stability. No method is currently available to include system effects in the analysis of C_p; however, a K_e factor of 0.8 may be used as a reasonable assumption to determine the effective buckling length, ℓ_e, which is then used to determine C_p (see NDS•3.7.1).

Testing has demonstrated that sheathed walls like the one in this example can carry ultimate axial loads of more than 5,000 plf (NAHB/RF, 1974; other unpublished data).