Conclusion

A 4x4 column is adequate for the 4,800-pound axial design load and the stated height and support conditions. In fact, a greater column spacing could be used. Note that the analysis was performed with a solid sawn column of rectangular dimension. If a nonrectangular column is used, buckling must be analyzed in the weak-axis direction in consideration of the distance between lateral supports, if any, in that direction. If a built-up column is used, it is NOT treated the same way as a solid column. Even if the dimensions are nearly the same, the built-up column is more susceptible to buckling due to slippage between adjacent members as flexure occurs in response to buckling (only if unbraced in the weak-axis direction of the built-up members). Slippage depends on how well the built-up members are fastened together, which is accounted for by the use of an additional adjustment (reduction) factor applied to the C_p equation (see Section 5.5.5 and NDS•15.3).

EXAMPLE 5.9 *Simply Supported Sloped Rafter Design*

Given

Two-story home
Rafter spacing 16 in on center
Rafter horizontal span is 12 ft (actual sloped span is 14.4 ft)
8:12 roof slope
Design loads (see Chapter 3):

Dead load	=	10 psf
Roof snow load	=	20 psf (20 psf ground snow)
Wind load (90 mph, gust)	=	12.7 psf (outward, uplift)
	=	7.4 psf (inward)
Roof live load	=	10 psf

Find Minimum rafter size using No. 2 Douglas-Fir-Larch (refer to Figure 5.7 for load diagram).

Solution

1. Evaluate load combinations applicable to rafter design (see Chapter 3, Table 3.1):

The load combinations to consider and initial assessment based on the magnitude of the given design loads follows

$D + (L_r \text{ or } S)$ Controls rafter design in inward-bending direction (compression side of rafter laterally supported); L_r can be ignored since the snow load magnitude is greater.

$0.6D + W_u$ May control rafter design in outward-bending direction since the compression side now has no lateral bracing unless specified; also important to rafter connections at the bearing wall and ridge beam.

$D + W$ Not controlling by inspection; gravity load D + S controls in the inward-bending direction.

2. Determine relevant lumber property values (NDS-S, Table 4A).

F_b = 900 psi
F_v = 95 psi
E = 1.6×10^6 psi