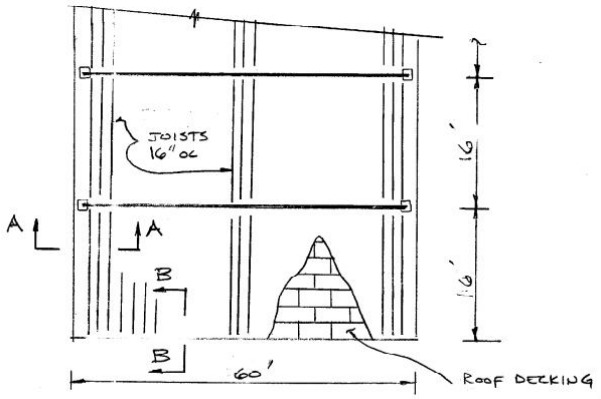
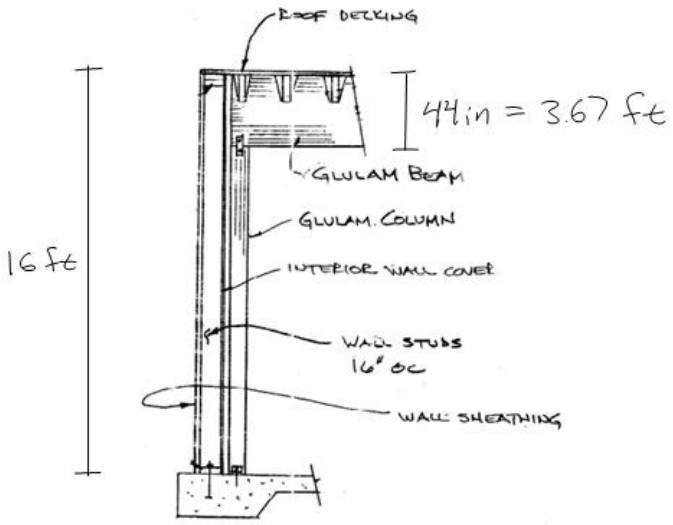
Given:



SCHEMATIC ROOF PLAN



$l := 16 - \frac{44}{12} = 12.333\ \text{ft}$ $t_w := 16\ \text{ft}$ $A_T := t_w \cdot 30 = 480\ \text{ft}^2$

Design Loads: Use a 6.75" X 6.875" column for ease of connection with beam (11.5 plf).

- Dead Load: FBC 2005, Appendix A (P. A.1-A.3)

  Plywood, rigid insulation, felt, gravel, HVAC, ceiling, joists, glulam beam (71 plf) and column self weight (11.5 plf)

  $$D := 3 \cdot \frac{5}{8} + 4 \cdot .75 + 0.7 \cdot 5 + 104 \cdot \frac{3}{12} + 4 + 2 + 7 + \frac{71 \cdot 30}{16 \cdot 30} + \frac{11.5}{16} = 52.5\ \text{psf}$$

- Wind Load:

  65.3 psf upward on 6 ft edge strips
  55.1 psf upward on interior
  19.4 psf downward

- Roof Live Load:

$L_0 := 20$ psf

$$R_1 := \begin{cases} 1 & \text{if } A_T \le 200 \\ \left(1.2 - 0.001 \cdot A_T\right) & \text{if } 200 < A_T < 600 \\ 0.6 & \text{if } A_T \ge 600 \end{cases} \qquad R_1 = 0.72 \qquad R_2 := 1.0$$

$L_R := L_0 \cdot R_1 \cdot R_2 = 14.4$ psf ASCE 7-10, Eqn. (4.8-1)

- Downward Load Cases:

Dead Load Only:

$P_D := A_T \cdot D = 2.522 \times 10^4$ lbs

Dead plus Roof Live:

$P_{D\_Lr} := A_T \cdot \left(D + L_R\right) = 3.213 \times 10^4$ lbs

*Dead plus 0.6*Wind:*

$P_{D\_W} := A_T \cdot (D + 0.6 \cdot 19.4) = 3.08 \times 10^4$ lbs

*Dead plus 3/4 of (Roof Live plus 0.6*Wind):*

$P_{D\_Lr\_W} := A_T \cdot \left[D + 0.75 \cdot \left(L_R + 0.6 \cdot 19.4\right)\right] = 3.459 \times 10^4$ lbs

- Upward Load Cases: 0.6*D+W [W-0.6*D upward] C_D=1.6

$T := 16 \cdot 6 \cdot 65.3 + 16 \cdot 24 \cdot 55.1 - A_T \cdot 0.6 \cdot D = 1.23 \times 10^4$ lbs

- Estimate Controlling Load Case:

Load Case:	Load (plf):	C_D:	Load/C_D:
1. D	25220	0.9	28022
2. D + L_R	32130	1.25	25704
5. D + 0.6*(W)	30800	1.6	19250
6a. D + 0.75*(L_R + 0.6*W)	34590	1.6	21619

Therefore, for axial compression use: $P := 25220$ lbs $C_D := 0.9$

Check Axial Compression:

*****Use a 6.75" X 6.875" (5 laminations) Southern Pine Glulam Column in order to provide ease of connection with beam.** NDS Supplement 2005, Table 1D, (P.25)

$A := 46.41\ in^2$ $r_x := 1.985\ in$ $r_y := 1.949\ in$

$d_x := 6.875\ in$ $d_y := 6.75\ in$

- Unbraced Length:

$l_x := l \cdot 12 = 148\ in$ $l_y := l_x = 148\ in$

$k := 1.0$ Assume pinned-pinned connection. NDS 2005, Appendix G (P.156)

- Actual Compressive Stress:

$f_c := \frac{P}{A} = 543.417\ psi$

- Allowable Compressive Stress: NDS 2005, Table 5.3.1 (P.34)

*****Use Identification #47:**

$F_c := 1900\ psi$ 4 or more laminations NDS Supplement 2005, Table 5B (P.66)

$E_{min} := 730000\ psi$ NDS Supplement 2005, Table 5B (P.66)

$C_D := 0.9$ NDS 2005, Table 2.3.2 (P.9)

$C_M := 1.0$ $EMC \leq 19\%$ NDS Supplement 2005, Table 4B (P.37)

$C_t := 1.0$ NDS 2005, Table 2.3.3 (P.9)

Column Stability Factor (C_P): NDS 2005, Section 3.7.1 (P.19)

$l_{ex} := k \cdot l_x = 148$ in $l_{ey} := k \cdot l_y = 148$ in

$\frac{l_{ex}}{d_x} = 21.527$

$\frac{l_{ey}}{d_y} = 21.926$ Controls

$F_{ce} := \frac{0.822 \cdot E_{min}}{\left(\frac{l_{ey}}{d_y}\right)^2} = 1.248 \times 10^3$ psi

$\left[F_c'\right] := F_c \cdot C_D \cdot C_M \cdot C_t = 1.71 \times 10^3$ psi

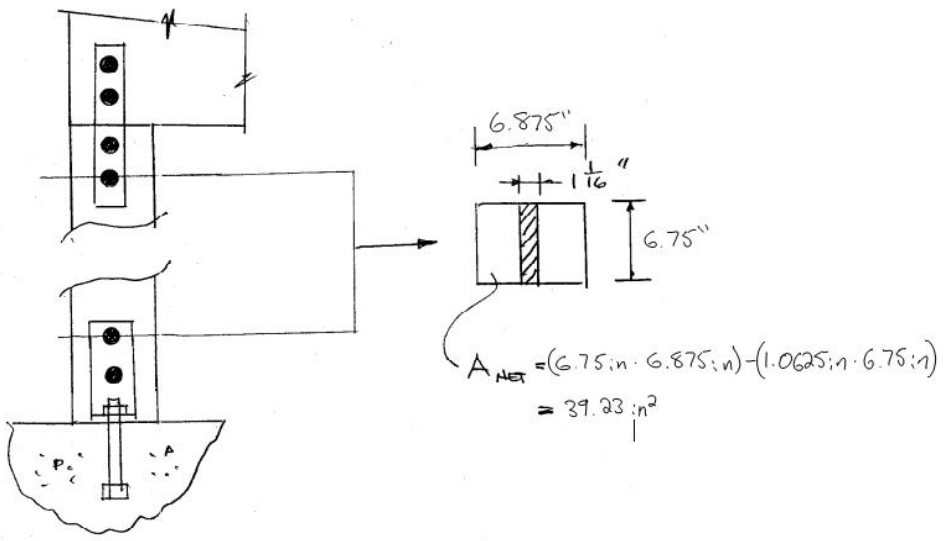
$c := 0.9$ Structural Glulam

$C_P := \frac{1 + \left(\frac{F_{ce}}{\left[F_c'\right]}\right)}{2.c} - \sqrt{\left[\frac{1 + \left(\frac{F_{ce}}{\left[F_c'\right]}\right)}{2 \cdot c}\right]^2 - \frac{\left(\frac{F_{ce}}{\left[F_c'\right]}\right)}{c}} = 0.625$ NDS 2005, Eqn. (3.7.1)

Therefore: $F'_c := F_c \cdot C_D \cdot C_M \cdot C_t \cdot C_P = 1.07 \times 10^3$ psi > $f_c = 543.417$ psi

Check Axial Tension

*****Assume a single row of 1" ϕ bolts in 1-1/16" ϕ holes.**



$$A_{net} := 39.23\ in^2$$

- Actual Tensile Stress:

$$f_t := \frac{T}{A_{net}} = 313.49\ psi$$

- Allowable Tensile Stress: NDS 2005, Table 5.3.1 (P.34)

$F_t := 1200\ psi$ NDS Supplement 2005, Table 5B (P.66)

$C_D := 1.6$ NDS 2005, Table 2.3.2 (P.9)

$C_M := 1.0$ $EMC \le 19\%$ NDS Supplement 2005, Table 4B (P.37)

$C_t := 1.0$ NDS 2005, Table 2.3.3 (P.9)

Therefore: $F'_t := F_t \cdot C_D \cdot C_M \cdot C_t = 1.92 \times 10^3\ psi$ > $f_t = 313.49\ psi$

Summary:

- **Use a 6.75" X 6.875" (5 Laminations) Southern Pine Glulam Column.**
- **Use Identification #47.**