

ASSUMPTIONS:

Using the Portal Method, assuming $V_e = 1/2 \cdot V_i$

Beam Length: 20 ft

Reference:

Faraji

Section

Eq/Fig/Table/Notes

1. N-S FRAME:

11.4

Table

| Floor/Load | Wind | Seismic | Total | Factored Load | Total Shear | h | Moment |
|------------|------|---------|-------|---------------|-------------|------|--------|
| Roof | 18 | 165.6 | 183.6 | 183.60 | 183.60 | 5.75 | 1055.7 |
| 4th | 30 | 124.2 | 154.2 | 154.20 | 337.80 | 5.75 | 1942.4 |
| 3rd | 30 | 82.8 | 112.8 | 112.80 | 450.60 | 5.75 | 2591.0 |
| 2nd | 27 | 41.4 | 68.4 | 68.40 | 519.00 | 11.5 | 5968.5 |
| Sum | | | 519 | 519.00 | | | |

*These relationships are based on the portal method: $V_t = 3V_i$

Brace forces can be obtained by applying the coefficient obtained with Mathcad to the total force found above.

$$h := 11.5 \text{ ft} \quad b_x := 20 \text{ ft} \quad E := 29 \cdot 10^3 \text{ ksi} \quad \theta := \text{atan}\left(2 \cdot \frac{h}{b_x}\right) = 0.855$$

Assumptions:

Assuming W21x93 $I_b := 2070 \text{ in}^4$

Assuming W10x45 $I_c := 248 \text{ in}^4$

+

Using a L shaped brace, with Area: $A := 6.45 \text{ in}^2$

Assuming Hinged Support for the braced frame, applying EQ. chapter 11:

Upper Stories Sub-Element:

For base story:

$$k_e := 6 \cdot E \cdot \frac{I_c}{h^3} = 2.837 \times 10^4$$

$$k_{ex} := 2 \cdot E \cdot \frac{I_c}{h^3} = 9.458 \times 10^3$$

$$k_i := 8 \cdot E \cdot \frac{I_c}{h^3} = 3.783 \times 10^4$$

$$k_{ib} := 2.4 \cdot E \cdot \frac{I_c}{h^3} = 1.135 \times 10^4$$

$$k_{frameup} := 1(2 \cdot k_e + 2 \cdot k_i) = 1.324 \times 10^5$$

$$k_{frameb} := 2 \cdot k_e + 2 \cdot k_i = 1.324 \times 10^5$$

$$k_{frame} := k_{frameup} + k_{frameb} = 2.648 \times 10^5$$

Finally, we have k_{brace} :

$$k_{brace} := 2 \cdot A \cdot E \cdot \frac{[\sin(\theta) \cdot (\cos(\theta))^2]}{h} = 1.057 \times 10^4$$

$k_r =$

0.04

Therefore the force per brace can be obtained by iterating the equation below through the different forces estimated through the different building stories, ie:

$$P_{brace} := P \cdot \frac{k_{brace}}{k_{frame}}$$

Table

| Floor/Load | Total Shear | Shear Interior | Shear Exterior | Brace Forces | Moment Interior | Moment Exterior | h | Moment Checks |
|------------|-------------|----------------|----------------|--------------|-----------------|-----------------|------|---------------|
| Roof | 183.60 | 61.20 | 30.60 | 7.34 | 351.90 | 175.95 | 5.75 | 1055.7 |
| 4th | 337.80 | 112.60 | 56.30 | 6.17 | 647.45 | 323.73 | 5.75 | 1942.4 |
| 3rd | 450.60 | 150.20 | 75.10 | 4.51 | 863.65 | 431.83 | 5.75 | 2591.0 |
| 2nd | 519.00 | 173.00 | 86.50 | 2.74 | 1989.50 | 994.75 | 11.5 | 5968.5 |
| 1st | | | | | | | | |
| Sum | | | | | | | | |

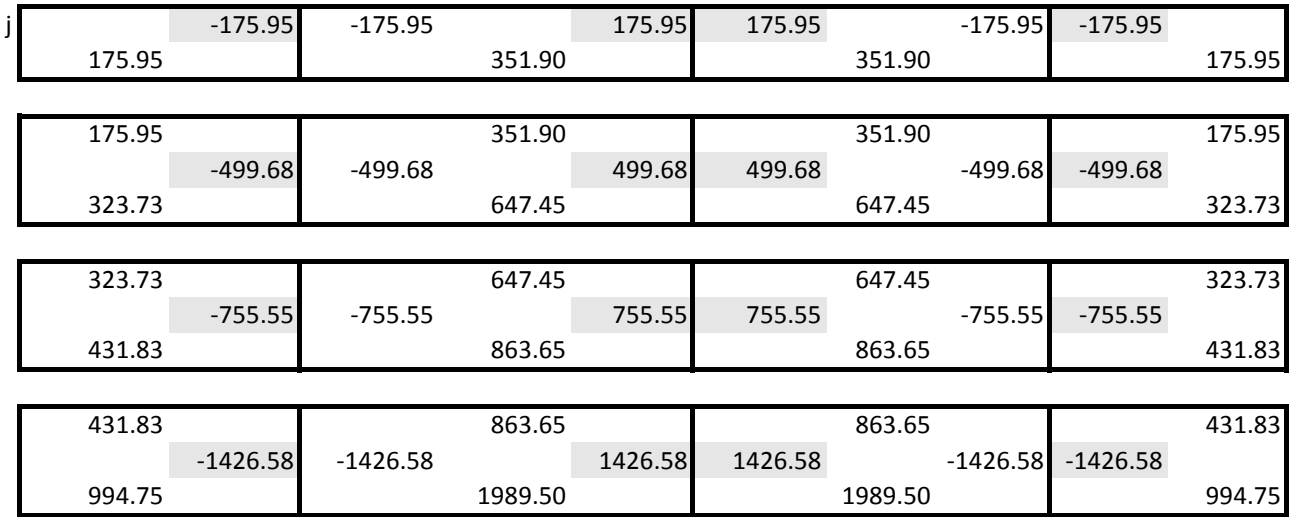


Figure 1 Column Moment Distribution through frame Joints

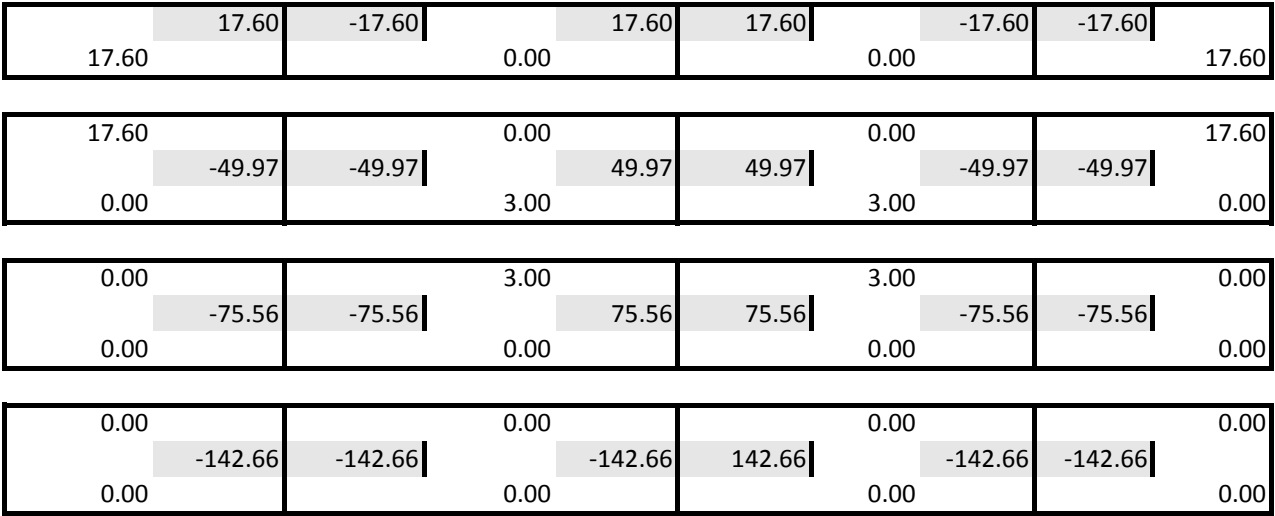


Figure 2 Shear and Axial Force Distribution through frame Joints