Therefore, the total ultimate capacity of the wall for wind loading is

$F_{ssw,ult,wall,wind}$ = 1,842 lb + 1,000 lb + 5,632 lb = 8,474 lb

Substituting the above values into the basic load-drift equation above, the following load-drift equations are determined for each segment:

Segment 1: $\Delta_1 = 2.41\text{x}10^{-9} (V_{d,1,wind})^{2.8}$ (inches)
Segment 2: $\Delta_2 = 1.45\text{x}10^{-8} (V_{d,2,wind})^{2.8}$ (inches)
Segment 1: $\Delta_3 = 2.41\text{x}10^{-10} (V_{d,3,wind})^{2.8}$ (inches)

Realizing that each segment must deflect equally (or nearly so) as the wall line deflects, the above deflections may be set equivalent to the total wall line drift as follows:

$\Delta_{wall} = \Delta_1 = \Delta_2 = \Delta_3$

Further, the above equations may be solved for V_d as follows:

Segment 1: $V_{d,1,wind} = 1,196 (\Delta_{wall})^{0.36}$
Segment 2: $V_{d,2,wind} = 630 (\Delta_{wall})^{0.36}$
Segment 3: $V_{d,3,wind} = 1,997 (\Delta_{wall})^{0.36}$

The sum of the above equations must equal the wind shear load (demand) on the wall at any given drift of the wall as follows:

$V_{d,wall,wind} = V_{d,1,wind} + V_{d,2,wind} + V_{d,3,wind} = 3,823 (\Delta_{wall})^{0.36}$

Solving for Δ_{wall} , the following final equation is obtained for the purpose of estimating drift and any given wind shear load from zero to $F_{ssw,ult,wall,wind}$:

$\Delta_{wall} = 9.32\text{x}10^{-11}(V_{d,wall,wind})^{2.8}$

For the design wind load on the wall of 3,000 lb as assumed in this example, the wall drift is determined as follows:

$\Delta_{wall} = 9.32\text{x}10^{-11}(3,000)^{2.8} = 0.51$ inches

Note: This analysis, as with most other methods of determining drift, may overlook many factors in the as-built construction that serve to increase or decrease drift. As discussed in Section 6.2, whole building tests seem to confirm that drift is generally over-predicted.

Conclusion

In this example, the determination of the design shear capacity of a segmented shear wall was presented for seismic design and wind design applications. Issues related to connection design for base shear transfer and overturning forces (chord tension and compression) were also discussed and calculations were made to estimate these forces using a conventional design approach. In particular, issues related to capacity-based design and "balanced design" of connections were discussed. Finally, a method to determine the load-drift behavior of a segmented shear wall line was presented. The final design may vary based on designer decisions and judgments (as well as local code requirements) related to the considerations and calculations as given in this example.

EXAMPLE 6.2 *Perforated Shear Wall Design*

Given

The perforated shear wall, as shown in the figure below, is essentially the same wall used in Example 6.1. The following dimensions are used:

h = 8 ft
L_1 = 3 ft
L_2 = 2 ft
L_3 = 8 ft
L = 19 ft
A_1 = 3.2 ft x 5.2 ft = 16.6 sf (rough window opening area)
A_2 = 3.2 ft x 6.8 ft = 21.8 sf (rough door opening area)

Wall construction:

- Exterior sheathing is 7/16-inch-thick OSB with 8d pneumatic nails (0.113 inch diameter by 2 3/8 inches long) spaced 6 inches on center on panel edges and 12 inches on center in panel field
- Interior sheathing is 1/2-inch-thick gypsum wall board with #6 screws at 12 inches on center
- Framing lumber is Spruce-Pine-Fir, Stud grade (specific gravity, G = 0.42); studs are spaced at 16 inches on center.

Loading condition (assumed for illustration):

Wind shear load on wall line = 3,000 lb
Seismic shear load on wall line = 1,000 lb