Starting at grid line 1:

$$F = -\frac{100+25}{2}(15) = -937.5 \text{ lb tension at start of SW5}$$

$$F = -937.5 + \frac{175+200}{2}(5) = 0 \text{ lb at grid line 2}$$

Therefore the force diagram closes. ▲

6.3 Diaphragm Deflection

The deflection equation shown in Fig. 6.5 was provided in APA's Design Example 3.

$$\Delta_{total} = \Delta_{side\ wall} + \Delta_{end\ wall} + \frac{v_{max}L}{2G_t} + 0.375Le_N + \frac{2\Delta_{end\ wall}L}{b}$$

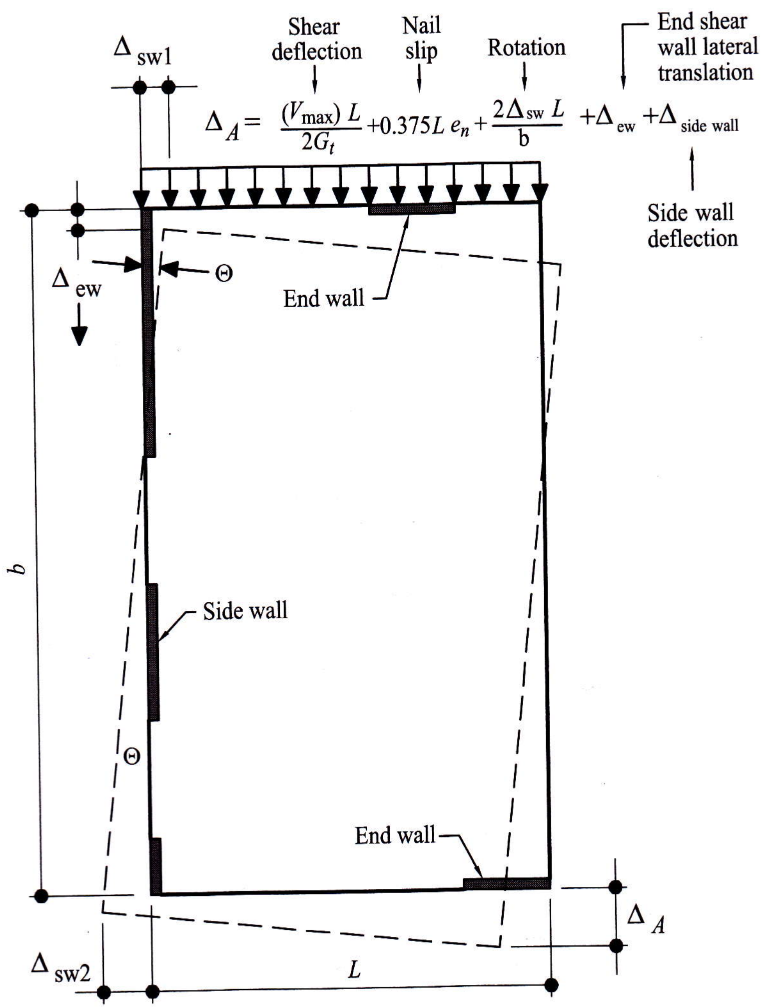

Figure 6.5 Diaphragm deflection.

The total deflection Δ_A is equal to the deflection of the shear walls along the side wall plus the shear deflection of the diaphragm, plus the diaphragm nail slip, plus the diaphragm rotation, plus the end wall deflection. The partial-length end walls contribute to the rotation and overall deflection of the diaphragm. The rotation shown in the equation is based on end walls of equal length. Whenever the lengths of the end walls are not equal, the displacement along the end wall lines will not be equal, as shown in the figure, Δ_{SW1} and Δ_{SW2}. A complete calculation of the deflection for unequal walls can be found in Chap. 7.

6.4 Open Front Both Sides

Occasionally, open front walls are desired on both sides of a diaphragm. At first glance, this layout may look questionable. However, the interior supporting wall is actually located closer to the resultant load, which reduces the eccentricity. As a result, smaller forces are applied to the end walls. The diaphragm shown in Fig. 6.6 has full-length collectors installed along grid line 2 as required by code. These collectors are required to provide a complete load path to transfer the diaphragm shears into the supporting interior shear walls. In the event a full-length collector cannot be installed, an alternate load path must be used. The diaphragm sections on each side of the interior shear walls must comply with the prescriptive restrictions of SDPWS Section 4.2.5, Figure 4A, unless calculations are provided showing that the deflections can be tolerated. In this example, the cantilever lengths on each side of the interior walls are unequal, which produces an eccentrically loaded diaphragm when loaded in the longitudinal direction. The analysis is similar to that of the open front diaphragm in Example 6.1. End zone wind pressures as shown in ASCE 7-05 Fig. 6-2 (if required by the method of analysis being used) are applied to the end of the longer cantilever, for the worst case, which increases the torsional moment. If grid line 2 is located in the middle of the diaphragm, creating equal cantilevers, a minimum eccentricity should be used in accordance with ASCE 7-05 Section 12.8.4.2. The torsional moment is resisted by the end shear walls located at grid lines A and B.

Example 6.2: Open Front Both Sides, Interior Shear Walls in Line

The diaphragm shown in Fig. 6.7 is 80 ft deep by 36 ft wide, with interior shear walls located at grid line 2 and end walls placed at grid lines A and B. A full-length collector is installed along grid line 2 to complete the required diaphragm boundary. The location of grid line 2 creates a 16 ft cantilever on the left side of the wall line and a 20 ft cantilever on the right. The diaphragm will be analyzed with the wind loads shown in the figure. The end zone wind pressure is placed at grid line 3 to produce the maximum eccentric load to the diaphragm. The strut force diagram at grid line A and the collector force diagram at grid line 2 will be determined.

Construction of basic shear diagram and wall shears (see Figs. 6.7 and 6.8):

$$R_2 = 200(32) + 250(4) = 7400 \text{ lb total shear at grid line 2}$$

Starting at grid line 1:

$$V_1 = 0 \text{ lb}$$

$$V_{2L} = -200(16) = -3200 \text{ lb total shear on left side of grid line 2}$$