strengths from load combinations that include wind loads were shown not to govern over load combinations that include seismic loads for both the braced frame and the moment frame. Therefore, wind loads are not included in the design examples in Part 3.

The necessary parameters for determining seismic loading are given with each design example.

## 3.4 MOMENT FRAMES

Moment frames resist lateral forces and displacements through flexure and shear in the beams and columns. The necessary restraint must be provided by the moment connections between the beam and the columns.

Moment frames tend to have larger and heavier beam and column sizes than braced frames. The increase in member sizes and related costs is often accepted to gain the increased flexibility provided in the architectural and mechanical layout in the structure. The absence of diagonal bracing members can provide greater freedom in the configuration of walls and in the routing of mechanical ductwork and piping. Moment frames are often positioned at the perimeter of the structure, allowing maximum flexibility of the interior spaces. Drift control is required by the applicable building code to help limit damage to both the structural and nonstructural systems.

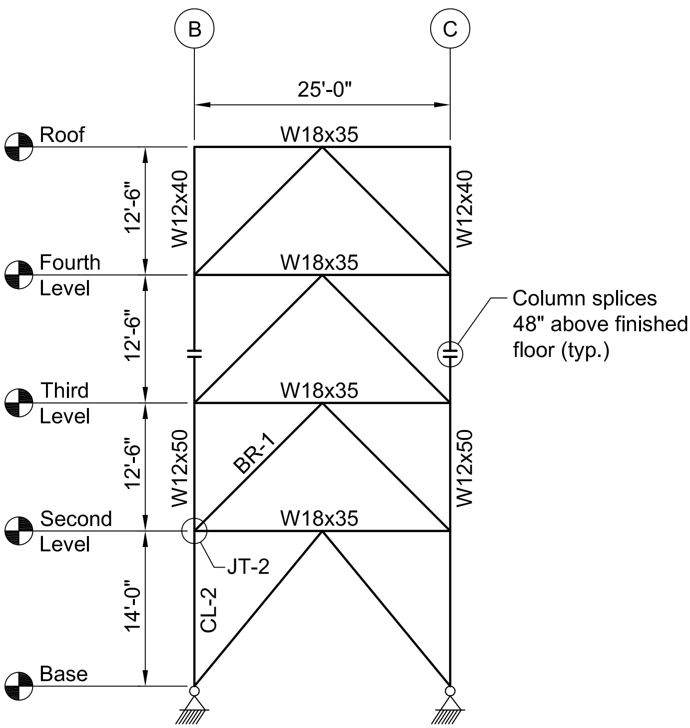


*Fig. 3-3. Braced frame elevation for Examples 3.5.1, 3.5.2 and 3.5.3. For floor plan, see Figure 3-1.*

Because the moment frame in the following examples does not require seismic detailing, it is designed in accordance with the provisions of the AISC *Specification*.

## Example 3.4.1. Moment Frame Story Drift Check

### Given:

Determine if the moment frame satisfies the ASCE/SEI 7 seismic story drift requirements.

Refer to the moment frame elevation shown in Figure 3-2. The applicable building code specifies the use of ASCE/SEI 7 for seismic story drift requirements. In accordance with ASCE/SEI 7:

Risk Category: II
Seismic Design Category: C
Deflection Amplification Factor, $C_d$: 3
Seismic Importance Factor, $I_e$: 1.0
Allowable Story Drift, $\Delta_a$: $0.020h_{sx}$

### Solution:

From a second-order elastic analysis of the structure, the elastic displacement computed under strength-level design earthquake forces at each level are:

$$\delta_{re} = 1.87 \text{ in.}$$
$$\delta_{4e} = 1.54 \text{ in.}$$
$$\delta_{3e} = 1.03 \text{ in.}$$
$$\delta_{2e} = 0.477 \text{ in.}$$
$$\delta_{be} = 0 \text{ in.}$$

The deflection at level $x$ is:

$$\delta_x = \frac{C_d \delta_{xe}}{I_e} \qquad \text{(ASCE/SEI 7 Eq. 12.8-15)}$$

The allowable story drift at level $x$, from ASCE/SEI 7 Table 12.12-1, is:

$$\Delta_a = 0.020h_{sx}$$

where

$h_{sx}$ = story height below level $x$, ft

Between the roof level and level 4:

$$\begin{aligned}\delta_r &= \frac{C_d(\delta_{re} - \delta_{4e})}{I_e} \\ &= \frac{3(1.87 \text{ in.} - 1.54 \text{ in.})}{1.0} \\ &= 0.990 \text{ in.}\end{aligned}$$

$$\Delta_a = 0.020(12.5 \text{ ft})(12.0 \text{ in./ft})$$
$$= 3.00 \text{ in.} > 0.990 \text{ in.} \quad \textbf{o.k.}$$

Between level 4 and level 3:

$$\delta_4 = \frac{C_d(\delta_{4e} - \delta_{3e})}{I_e}$$
$$= \frac{3(1.54 \text{ in.} - 1.03 \text{ in.})}{1.0}$$
$$= 1.53 \text{ in.}$$
$$\Delta_a = 0.020(12.5 \text{ ft})(12.0 \text{ in./ft})$$
$$= 3.00 \text{ in.} > 1.53 \text{ in.} \quad \textbf{o.k.}$$

Between level 3 and level 2:

$$\delta_3 = \frac{C_d(\delta_{3e} - \delta_{2e})}{I_e}$$
$$= \frac{3(1.03 \text{ in.} - 0.477 \text{ in.})}{1.0}$$
$$= 1.66 \text{ in.}$$
$$\Delta_a = 0.020(12.5 \text{ ft})(12.0 \text{ in./ft})$$
$$= 3.00 \text{ in.} > 1.66 \text{ in.} \quad \textbf{o.k.}$$

Between level 2 and the base level:

$$\delta_2 = \frac{C_d(\delta_{2e} - \delta_{be})}{I_e}$$
$$= \frac{3(0.477 \text{ in.} - 0 \text{ in.})}{1.0}$$
$$= 1.43 \text{ in.}$$
$$\Delta_a = 0.020(14.0 \text{ ft})(12.0 \text{ in./ft})$$
$$= 3.36 \text{ in.} > 1.43 \text{ in.} \quad \textbf{o.k.}$$

**Comment:**

In this case, the member sizes resulted from strength requirements. The seismic story drift requirements do not always govern the design of moment frames.

## Example 3.4.2. Moment Frame Column Design

**Given:**

Refer to Column CL-1 in Figure 3-2. Verify that a W12×87 ASTM A992 W-shape is sufficient to resist the following required strengths between the base and second levels. The applicable building code specifies the use of ASCE/SEI 7 for calculation of loads.

The load combinations that include seismic effects are: