Seismic and site data

The building is located in Oakland, California near the Hayward Fault. The values of maximum considered earthquake ground motion are read from seismic maps for periods of 0.2 seconds and 1.0 seconds. These maps are included in Chapter 16, §1615 and are also available in large readable format from FEMA. The maps are formatted for a typical site class B and for 5-percent damping.

$S_s = 2.10$ g	F 1615(3)
$S_1 = 0.93$ g	F 1615(5)
$I_E = 1.0$ (Category I)	T 1604.5, §1616.2
Seismic Use Group I	§1616.2
Seismic Design Category D	T 1616.3(1) & (2)
Soil profile type = S_D	

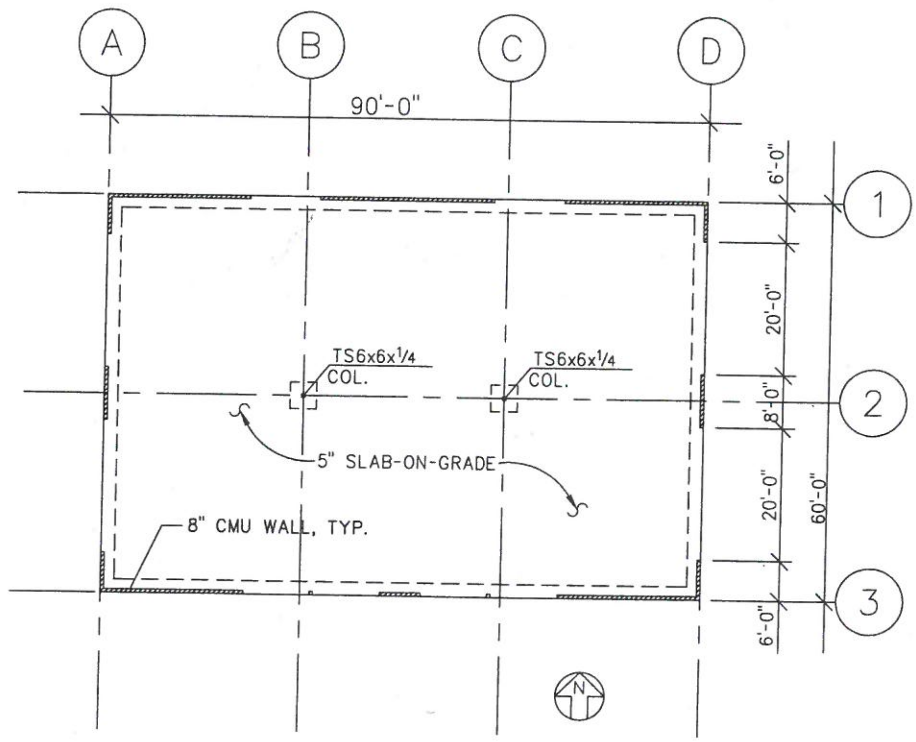

Figure 4-2. Floor plan

Single - Story Building

will transfer 50 percent of the diaphragm shear to each resisting wall. However, in a building that is not symmetric or does not have symmetric wall layouts, the wall lines could have slightly different wall shears on opposing wall lines 1 and 3 and also on A and D.

The building weight (mass) calculation is separated into three portions: the roof, longitudinal walls, and transverse walls, for ease of application at a later stage in the calculations. The reason for separating the CMU wall masses is that masonry walls that resist ground motions parallel to their in-plane directions resist their own seismic inertia without transferring seismic forces into the roof diaphragm. This concept will be demonstrated in the example below for the transverse (N-S) direction.

For the transverse direction, the roof diaphragm resists seismic inertia forces originating from the roof diaphragm and the longitudinal masonry walls (out-of-plane walls oriented east-west) on lines 1 and 3, which are oriented perpendicular to the direction of seismic ground motion. The roof diaphragm then transfers its seismic forces to the transverse masonry walls (in-plane walls oriented north-south) located on lines A and D. The transverse walls resist seismic forces transferred from the roof diaphragm and seismic forces generated from their own weight. Thus, seismic forces are generated from three sources: the roof diaphragm, in-plane walls at lines 1 and 3, and out-of-plane walls at lines A and D.

The design in the orthogonal direction is similar and the base shear is the same; however, the proportion of diaphragm and in-plane seismic forces is different. The orthogonal analysis is similar in concept, and thus is not shown in this example.

Roof weight

$$W_{roof} = 17 \text{ psf } (5400 \text{ sf}) = 92 \text{ kips}$$

Longitudinal wall weight (out-of-plane walls)
Note that the upper half of the wall weight is tributary to the roof diaphragm. This example neglects openings in the top half of the walls.

$$W_{walls,\ long.} = 75 \text{ psf } (2 \text{ walls})(92 \text{ ft})(19 \text{ ft})\left(\frac{19 \text{ ft}}{2}\right)\left(\frac{1}{16 \text{ ft}}\right) = 75 \text{ psf } (180 \text{ ft}) \frac{(19 \text{ ft})^2}{2(16 \text{ ft})} \; 152 \text{ kips}$$

For forces in the transverse direction, seismic inertial forces from the transverse walls (lines A and D) do not transfer through the roof diaphragm. Therefore, the effective diaphragm weight in the N-S direction is

$$W_{trans.diaph.} = W_{roof} + W_{walls,\ long.} = 92 \text{ k} + 152 \text{ k} = 244 \text{ kips}$$

The transverse seismic inertial force (shear force), which is generated in the roof diaphragm, is calculated as follows

$$V_{trans.diaph.} = 0.280 W_{trans.diaph.} = 0.280(244 \text{ kips}) = 68 \text{ kips}$$