For the seismic design lateral loads in this example, the garage opening is not so severely loaded. The design seismic load on the Wall Line A is 745 lb. Using the approach above (and substituting a safety factor of 2.5 for seismic design), the value of $F_{s,ext}$ determined is 905 plf which is much less than the 2,004 plf determined for the design wind shear load condition assumed in this example. By inspecting Table 6.1, 7/16-inch-thick Structural 1 sheathing is sufficient and the pnuematic nails used on the rest of the building's shear walls may be used. However, this requires the two garage return walls to be restrained with two hold-down brackets each as in the segmented shear wall design method. For the seismic load, the garage opening wall (Wall Line A) may be suitably designed as a perforated shear wall and eliminate the need for two of the four hold-downs. A portal frame may also be considered for the garage opening (see Section 6.5.2.7).

Wall Line D/E may be designed in a similar fashion to the options discussed above. In fact, Wall Line E may be eliminated as a designed shear wall line provided that a collector is provided to bring the diaphragm shear load into the single wall segment in wall line D (see the dotted line on the floor plan figure). Of course, Wall line D must be designed to carry the full design shear load assigned to that end of the building. Collector design was illustrated in Example 6.3. The connections for overturning (i.e., hold-downs) and base shear transfer must be designed as illustrated in Examples 6.1 and 6.2. As an additional option, Wall Line C may be designed as an interior shear wall line and the wood structural panel sheathing would be placed underneath the interior finish. This last option would relieve some of the load on the house end walls and possibly simplify the overall shear wall construction details used in the house.

3. Determine the shear loads on the N-S shear wall lines using the relative stiffness method and an assumed shear wall construction for the given seismic design condition only.

Assume that the shear wall construction will be as follows:

- 7/16-inch OSB Structural I wood structural panel sheathing with 8d common nails (or 0.131-inch diameter 8d pneumatic nails) spaced at 4 inches on center on the panel edges and 12 inches in the panel field.
- Douglas-fir wall framing is used with 2x studs spaced at 16 inches on center.
- Walls are designed as perforated shear wall lines and adequate hold-downs and base shear connections are provided.

It will be further assumed that the house and garage are sufficiently tied together to act as a structural unit. It must be remembered that the relative stiffness design approach is predicated on the assumption that the horizontal diaphragm is rigid in comparison to the supporting shear walls so that the forces are distributed according to the relative stiffness of the shear wall lines. This assumption is exactly opposite to that assumed by use of the tributary area method.

As given for the design example, the following design seismic shear loads apply to the first story of the example building:

Design N-S Seismic Lateral Load (mapped $S_s = 1.5g$)

House: 7,493 lb total story shear (tributary weight is 37,464 lb)
Garage: 1,490 lb total story shear (tributary weight is 7,452 lb)
Total: 8,983 lb total story shear (total tributary weight is 44,916 lb)

Locate the center of gravity

The first step is to determine the center of gravity of the building at the first story level. The total seismic story shear load will act through this point. For wind design, the process is similar, but the horizontal wind forces on various portions of the building (based on vertical projected areas and wind pressures) are used to determine the force center for the lateral wind loads (i.e., the resultant of the garage and house lateral wind loads).

Establishing the origin of an x-y coordinate system at the bottom corner of Wall Line B of the example first floor plan, the location of the center of gravity is determined by taking weighted moments about each coordinate axis using the center of gravity location for the garage and house portions. Again, the “bump-out” area in living room is considered to have negligible impact on the estimate of the center of gravity since most of the building mass is originating from the second story and roof which does not have the “bump-out” in the plan.

The center of gravity of the garage has the (x,y) coordinates of (-11 ft, 16 ft). The center of gravity of the house has the coordinates (21 ft, 14 ft).

Weighted moments about the y-axis:

$X_{cg,building}$ = [($X_{cg,garage}$)(garage weight) + ($X_{cg,house}$)(house weight)]/(total weight)
= [(-11 ft)(7,452 lb) + (21 ft)(37,464 lb)]/(44,916 lb)
= 15.7 ft

Weighted moments about the x-axis:

$Y_{cg,building}$ = [($Y_{cg,garage}$)(garage weight) + ($Y_{cg,house}$)(house weight)]/(total weight)
= [(16 ft)(7,452 lb) + (14 ft)(37,464 lb)]/(44,916 lb)
= 14.3 ft

Thus, the center of gravity for the first story is located at the (x,y) coordinates of (15.7 ft, 14.3 ft). The approximate location on the floor plan is about 4 inches north of the center bearing wall line and directly in front of the stair well leading down (i.e., about 5 feet to the left of the center of the house).