Notes:

1. The contribution of the interior walls to the lateral resistance is neglected in the above analysis for wind and seismic loading. As discussed in Chapter 6, these walls can contribute significantly to the lateral resistance of a home and serve to reduce the designated shear wall loads and connection loads through alternate, "non-designed" load paths. In this example, there is approximately 40 ft of interior partition walls in the N-S direction that each have a minimum length of about 8 ft or more (small segments not included). Assuming a design unit shear value of 80 plf / 2 = 40 plf (safety factor of 2), the design lateral resistance may be at least 40 ft x 40 plf = 1,600 lb. While this is not a large amount, it should factor into the design consideration, particularly when a lateral design solution is considered to be marginal based on an analysis that does not consider interior partition walls.
2. Given the lower wind shear load in the E-W direction, the identical seismic story shear load in the E-W direction, and the greater available length of shear wall in the E-W direction, an adequate amount of lateral resistance should be no problem for shear walls in the E-W direction. It is probable that some of the available E-W shear wall segments may not even be required to be designed and detailed as shear wall segments. Also, with hold-down brackets at the ends of the N-S walls that are detailed to anchor a common corner stud (to which the corner sheathing panels on each wall are fastened with the required panel edge fastening), the E-W walls are essentially perforated shear wall lines and may be treated as such in evaluating the design shear capacity of the E-W wall lines.
3. The distribution of the house shear wall elements appears to be reasonably "even" in this example. However, the garage opening wall could be considered a problem if sufficient connection of the garage to the house is not provided to prevent the garage from rotating separately from the house under the N-S wind or seismic load. Thus, the garage walls and garage roof diaphragm should be adequately attached to the house so that the garage and house act as a structural unit. This process will be detailed in the next part of this example.

2. Determine the design shear load on each wall line based on the tributary area method.

Following the tributary area method of horizontal force distribution, the loads on the garage and the house are treated separately. The garage lateral load is assumed to act through the center of the garage and the house load is assumed to act through the center of the house. The extension of the living room on the right side of the plan is only one story and is considered negligible in its impact to the location of the real force center; although, this may be considered differently by the designer. Therefore, the lateral force (load) center on the garage is considered to act in the N-S direction at a location one-half the distance between wall lines A and B (see the given floor plan diagram). Similarly, the N-S force center on the house may be considered to act half-way between wall lines B and D (or perhaps a foot or less farther to the right to compensate for the living room "bump-out"). Now, the N-S lateral design loads are assigned to wall lines A, B, and D/E as follows:

<u>Wall Line A</u>

Wind design shear load = 1/2 garage shear load = 0.5(3,928 lb) = 1,964 lb
Seismic design shear load = 0.5(1,490 lb) = 745 lb

<u>Wall Line B</u>

Wind design shear load = 1/2 garage shear load + 1/2 house shear load
= 1,964 lb + 0.5(17,411 lb) = 10,670 lb
Seismic design shear load = 745 lb + 0.5(7,493 lb) = 4,492 lb

Wall Line D/E

Wind design shear load = 1/2 house shear load = 0.5(17,411 lb) = 8,706 lb
Seismic design shear load = 0.5(7,493 lb) = 3,747 lb

Based on the design shear loads above, each of the wall lines may be designed in a fashion similar to that used in Step 1 (total shear method) by selecting the appropriate wall construction to meet the loading demand. For example, the design of wall line B would proceed as shown below (using the perforated shear wall method in this case) for the required wind shear load.

The following equations are used to determine the required ultimate shear capacity, F_s, of the wall construction (interior and exterior sheathing type and fastening):

$F'_s = [(F_{s,ext})(C_{sp})(C_{ns}) + F_{s,int}]x[1/SF]$ (based on Eq. 6.5-1a)
$F_{psw} = F'_s\, C_{op}\, C_{dl}\, [L]$ (Eq. 6.5-1b)

Substituting the first equation above into the second,

$F_{psw} = [(F_{s,ext})(C_{sp})(C_{ns}) + F_{s,int}]\, [1/SF]\, C_{op}\, C_{dl}\, [L]$

To satisfy the design wind shear load requirement for Wall Line B,

$F_{psw} \geq 10{,}670$ lb

Assume that the wall construction is the same as used in Example 6.2. The following parameters are determined for Wall Line B:

$C_{sp} = 0.92$	(Spruce-Pine-Fir)
$C_{ns} = 0.75$	(8d pneumatic nail, 0.113-inch-diameter)
$C_{dl} = 1.0$	(zero dead load due to wind uplift)
SF = 2.0	(wind design safety factor)
$C_{op} = 0.71$	(without the corner window and narrow segment)*
L = 28 ft – 1.33 ft – 3 ft = 23.67 ft	(length of perforated shear wall line)*
$F_{s,int} = 80$ plf	(Table 6.3, minimum ultimate unit shear capacity)

*The perforated shear wall line begins at the interior edge of the 3’ x 5’ window opening because the wall segment adjacent to the corner exceeds the maximum aspect ratio requirement of 4. Therefore, the perforated shear wall is “embedded” in the wall line.

Substituting the values above into the equation for F_{psw} , the following value is obtained for $F_{s,ext}$:

10,670 lb = $[(F_{s,ext})(0.92)(0.75) + 80$ plf$]\, [1/2.0]\, (0.71)\, (1.0)\, [23.67$ ft$]$

$F_{s,ext} = 1{,}724$ plf

By inspection in Table 6.1, the above value is achieved for a shear wall constructed with 15/32-inch-thick Structural 1 wood structural panel sheathing with nails spaced at 3 inches on the panel edges. The value is 1,722 plf which is close enough for practical purposes (particularly given that contribution of interior walls is neglected in the above analysis). Also, a thinner sheathing may be used in accordance with Footnote 5 of Table 6.1. As another alternative, wall line B could be designed as a segmented shear wall. There are two large shear wall segments that may be used. In total they are 20 ft long. Thus, the required ultimate shear capacity for wall line B using the segmented shear wall method is determined as follows: