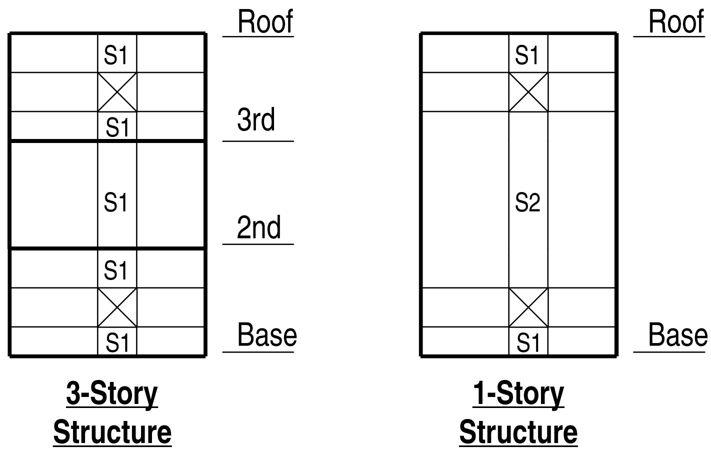



**Figure 4: Additional Examples of Wall Spandrel Labeling**

# Wall Meshing and Vertical Loading

You must manually mesh the walls in your model. No automatic wall meshing is available in the program. The meshing tools are available on the Edit menu. This section provides a few additional comments about wall meshing.

It is important to understand that loads are only transferred to walls at the corner points of the area objects that make up the wall. Consider the example shown in Figure 5a, which illustrates the load transfer associated with a floor deck connecting to a wall. The transfer of load only occurs at the joints (corner points) of the area objects.

Figure 5b illustrates the loads that are transferred to the wall as P1, P2, P3, and P4. Those loads are obtained as follows:

- Load P1 comes from the end reaction of Beam 1 and from the uniform load in the floor area labeled 1.
- Load P2 comes from the uniform load in the floor area labeled 2.

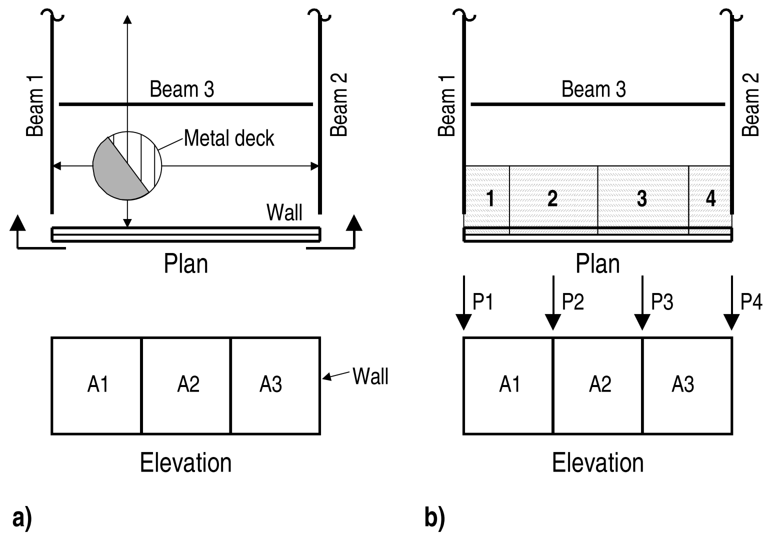
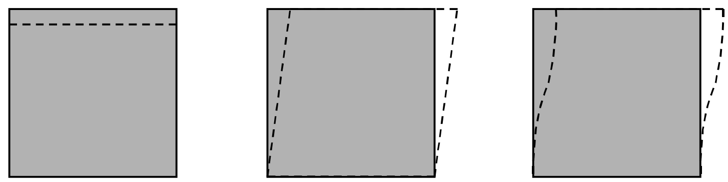



**Figure 5: Example of Floor Deck Connecting to a Wall**

- Load P3 comes from the uniform load in the floor area labeled 3.
- Load P4 comes from the end reaction of Beam 2 and from the uniform load in the floor area labeled 1.

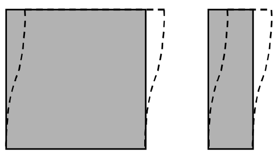
Thus, the uniform floor load is not transferred to the wall as a uniform load. Instead, it transfers as a series of point loads. The point loads are located at the corner points of the area objects that make up the wall.

Consider Figure 6, which shows three types of deformation that a single shell element could experience. A single shell element in the program captures shear and axial deformations well. A single shell element is unable to capture bending deformation. Thus, in piers and spandrels where bending deformations are significant (slender piers and spandrels), you may want to mesh the pier or spandrel into several elements.



a) Axial Deformation b) Shear Deformation c) Bending Deformation

**Figure 6: Shell Element Deformation**



a) b)

For example, consider the shell elements shown in the sketch to the left. Bending deformations in shell "a" are probably insignificant and thus no further meshing is needed. The bending deformations in shell "b" may be significant and thus you may want to mesh it into additional shell elements.

Now consider the wall shown in Figure 7. Figure 7a shows the wall modeled with five shell elements. Because the aspect ratio of the shell elements is good—that is, they are not long and slender—bending deformations should not be significant, and thus, no further meshing of the wall is necessary to accurately capture the results.

Figure 7b shows the same wall with the opening shifted to the left, such that the left pier becomes slender. In that case, bending deformations may be significant in that pier, and thus, it is meshed into two shell elements.

Figure 7c shows the same wall with the opening made taller, such that the spandrel beam becomes slender. In that case, bending deformations may be significant in the spandrel, and thus, it is meshed into four shell elements. Meshing it into four elements rather than two helps it to better capture the gravity load bending. As the spandrel becomes more slender, you may want to use a frame element to model it.

No specific rule exists to determine when to mesh a pier or spandrel element into additional shell elements to adequately capture bending deformation. It is really best addressed by doing comparative analyses with and without the additional meshing and applying some engineering judgment. Nevertheless, we suggest that if the aspect ratio of a pier or spandrel that is modeled with

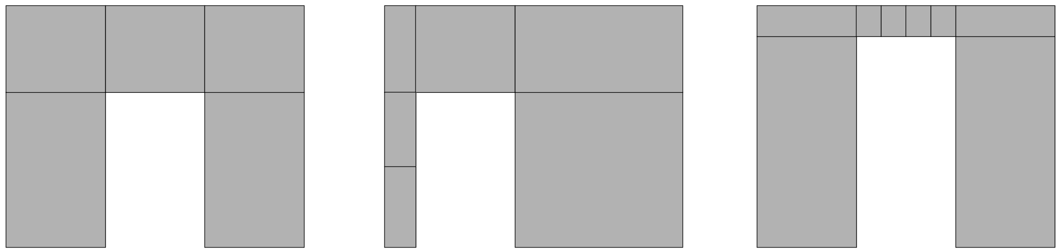



**Figure 7: Shell Element Meshing Example for Piers and Spandrels**

one shell element is worse than 3 to 1, consider additional meshing of the element to adequately capture the bending deformation.

### Using Frame Elements to Model Spandrels

When using a frame element (beam) to model a shear wall spandrel, keep in mind that the analysis results obtained are dependent on the fixity provided by the shell element that the beam connects to. Different sized shell elements provide different fixities and thus, different analysis results.

In general, for models where the spandrels are modeled using frame elements, better analysis results are obtained when a coarser shell element mesh is used; that is, when the shell elements that the beam connects to are larger. If the shell element mesh is refined, consider extending the beam into the wall at least one shell element to model proper fixity.

If the depth of the shell element approaches the depth of the beam, consider either extending the beam into the wall as mentioned above, or modeling the spandrel with shell elements instead of a frame element.

## Analysis Sections and Design Sections

It is important to understand the difference between analysis sections and design sections when performing shear wall design. Analysis sections are simply the objects defined in your model that make up the pier or spandrel section. The analysis section for wall piers is the assemblage of wall and column sections that make up the pier. Similarly, the analysis section for spandrels is the assemblage of wall and beam sections that make up the spandrel.