



Masonry Myth: Wall Weight

When designing a typical low-rise building, a thought that may enter an engineer's mind is whether masonry walls are too heavy and will lead to larger foundations. A lighter wall would require smaller and less expensive foundations, correct? This is not necessarily the case, and this way of thinking can sometimes lead to inefficient design.

A number of soil properties are essential when designing foundation elements, such as allowable soil bearing capacity for footings, end bearing pressure, and skin friction values for drilled pier foundations. The geotechnical engineer will also set minimum dimensions for the foundation elements, like minimum continuous footing width; or minimum pier diameter, length, and penetration into bearing material. For footings, the typical bearing pressure is 2000 to 6000 pounds per square foot, while a typical minimum width for a continuous footing is 2-feet. This will result in a continuous footing capacity of four to twelve kips per linear foot.

Examples

Here are some examples. In the first scenario, assume a one-story building with 30-foot by 30-foot interior bays. The roof has loads of 25 psf dead and 50 psf live/snow. Assuming a typical concrete stem wall on the continuous footing and a 2000 psf allowable soil pressure, the minimum 2-foot wide continuous footing would be able to support an 8-inch, normal weight, solid grouted masonry wall that is 27 feet tall. That is reasonably tall for an 8-inch wall, so if a 12-inch masonry wall with grout at 16-inches is used, the minimum footing can support a 22-foot high wall. Thus, for this building, if a lightweight material is used for a wall that is 22-feet tall or less, the continuous footing has extra capacity that is not being used.

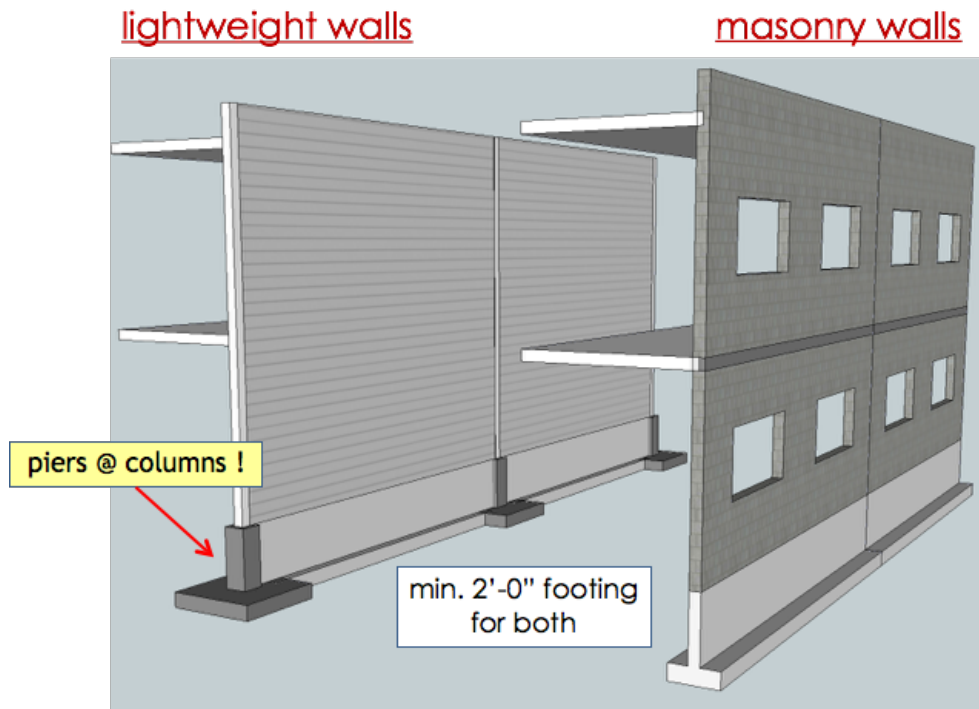
Next is the case of a two-story building with the same 30 foot by 30 foot bays. Checking a floor with a concrete slab on deck, a typical reducible office live load, the same roof load as the previous example, and a 12-inch wall grouted at 16-inches that is 24-feet tall, the minimum two foot wide footing works with a bearing pressure of 3000 psf. In other words, if the allowable soil bearing pressure is at least 3000 psf, the same footing will be required whether the walls are 12-inch masonry or a lightweight material.

Cost Comparison

Another item to consider with lightweight walls is that columns will be necessary to support gravity loads. Under these columns, larger spread footings will be required, adding to the volume of concrete and labor. In this instance, the lightweight wall option could require more concrete for the foundations. A 3-foot

wide by 1-foot thick continuous footing under a masonry wall equals three cubic feet of concrete per foot length of wall. Meanwhile, a 2-foot wide by one foot thick continuous footing with 5'-0x5'-0x1'-4 spread footings at 30-feet would require 3.11 cubic feet of concrete per foot length of wall. Even though the typical footing is narrower than for the masonry wall, the need for spread footings under the columns makes the concrete volume greater for the lightweight wall option.

2, 3, & 4 stories



There are many variables that could affect these loads—smaller snow loads, lightweight concrete floors, interior bay size, masonry wall size, and grout spacing—so it may not always be the case that masonry walls have a foundation advantage. However, there are numerous cases in low-rise construction where load-bearing masonry walls require less foundation material than post and beam solutions with lighter wall weight options. Though seemingly counter-intuitive, switching to a lightweight non-load bearing wall may in fact be more expensive.