

Less Foundations for Load Bearing Masonry Walls

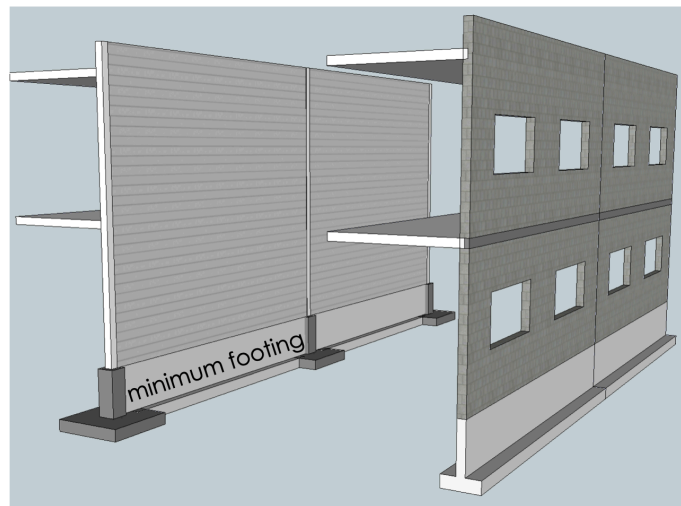
When designing a typical low-rise building, a thought that can sometimes enter a designer’s mind is that masonry walls are too heavy and will lead to larger foundations. A lighter wall would need smaller and less expensive foundations, right? This is not necessarily the case, and this way of thinking can sometimes lead to inefficient designs.

A number of soil properties are required when designing foundation elements, such as allowable soil bearing capacity for footings and 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 two feet. This will result in a continuous footing capacity of four to twelve kips per linear foot.

Foundation Difference

Which system requires less foundations?
Load Bearing Walls

- Most of the building weight is in the floor system, and floor occupancy
- The individual column footings are required to have the similar load requirements as the strip footing in the load-bearing wall
- The non-load bearing wall still requires a “minimum foundation”, above and beyond the foundation for the floors
- Therefore, in most scenarios:
 - Post & Beam & Non-Load Bearing Walls actually have more foundations
 - Simple Load Bearing Walls have less foundations



Post & Beam and Non-Load Bearing Walls

Load-bearing Walls



The following are examples. First, 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 two foot wide continuous footing would be able to support an eight inch, normal weight, solid grouted masonry wall that is 27 feet tall. That is pretty 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. This means that 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.

The following is a case of a two story building with the same 30x30 foot bays. Checking a floor with a concrete slab on deck and 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 2 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.

Another item to consider with lightweight walls is that columns will be needed to support gravity loads, and under these columns, larger spread footings will be required. This adds to the volume of concrete and labor, and it could be that the lightweight wall option ends up requiring more concrete for the foundations. A three foot wide by one foot thick continuous footing under a masonry wall equals three cubic feet of concrete per foot length of wall. Meanwhile, a two 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.

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 many instances in low-rise construction where load-bearing masonry walls require less foundation material than post and beam solutions with lighter wall weight options. Therefore, though it may seem counterintuitive, switching to a lightweight non-load bearing wall may in fact cost more.