

Shallow Foundations

By Robert Koci

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A proper mix of soil, drainage and insulation can deliver even two-foot foundations safely.

Frost is the mortal enemy of home builders. Frost heaves can dislodge or crack concrete, which is why most builders dig at least a four-foot-deep foundation for their new homes. Yet, in many cases, they are throwing money down a hole.

Deep foundations are expensive. There are foundation walls, blocks and back-hoes and trucks to haul the dirt away, plus the time factor.

How much money could you save yourself if you only had to dig down two feet instead of four? The engineering that allows you to do exactly that has been around for over 30 years, yet Canadian builders and local building regulators seem too afraid to change their thinking. The result is that builders and homeowners may be spending thousands of dollars more per foundation than they need to.

It's important to point out that a shallow foundation doesn't mean a concrete slab-on-grade. A slab-on-grade is usually built with a grade beam

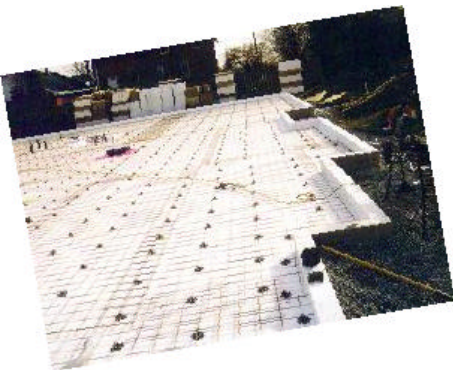
undergirding the perimeter of the slab. It is reinforced with steel rebar and is not frost-protected (there is such a thing as a frost-protected slab-on-grade but it is not done in Canada). The grade beam and slab are usually designed to "float" as a single unit above the frost line. As a result, it moves and cannot be used as a foundation for a home.

A shallow foundation, on the other hand, is a true foundation wall, usually between 10 inches and 2 ½ feet deep, that is installed separate from the flooring slab and designed as a stable, frost-resistant platform.

Frost Line Can Be Managed

Frost occurs when cold air lowers soil temperature and causes the moisture in the soil to freeze into crystals. Water is drawn to the crystals to form ice "lenses" that expand and causes upward pressure in the ground.

The frost line is typically considered to be a fairly uniform line describing the maximum depth at which frost is found in a specific geographical location. It is not hard to determine. It is usually calculated from what meteorologists call an "air freezing index." Building departments across Canada know the index for their area and calculate the frost line level from it. In reality, however, localized factors have a big impact on where the line is at each potential building site. Soil laden with humus or peat moss will resist frost and raise the line. A large body of water nearby that moderates air temperature will raise the line also. Gravel or coarse sand allows frost to penetrate deeper into the soil and will lower it.



The point is, the frost line can be managed and, with the proper understanding of what causes frost and how to control it, builders can reduce the required depth of a foundation considerably and save themselves thousands of dollars.

Three factors contribute to frost formation: soil composition, the amount of water in the soil, and soil temperature. The first two factors are related because the amount of water available for freezing is determined in large measure by soil composition. Soil that drains easily contains less water, and so reduces the risk of frost. All the standard moisture controls must be in place — good drainage away from the house, gutters properly installed, and weepers bedded in gravel — but in addition, a builder can replace the frost-susceptible soil like clay and silt with non-frost-susceptible material like gravel. This can be done underneath the foundation wall as well as on the vertical face.

Ultimately, controlling the temperature is the most reliable way to raise the frost line to accommodate a shallow foundation. It is not as hard as it sounds. The easiest way to increase the temperature of the soil is to place insulation around the building in such a way that heat generated by the building's heating system is trapped around the foundation wall.

The most common method is rigid styrofoam insulation installed horizontally around the outside of the house just above the footings. As the heat from the house tries to escape the house by traveling under and through the

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foundation wall, the insulation traps it under the soil and stops frost from forming under the foundation.

The most difficult part of building a house on a shallow foundation is convincing local building authorities that it is a viable and safe method of construction. Despite the fact that over half of all houses built in Scandinavia are now built on foundations no more than 2½ feet in depth in climates much colder than the most populated areas of Canada, Canadian municipalities are reluctant to accept the procedure without an engineer's stamp. It's not as if Canadians have never heard of shallow construction. A careful look at the Ontario

Building Code reveals that shallow foundations can be built under its guidelines but you have to be really looking to see it. Over 10 years ago the U.S.-based National Home Building Research Center translated and published a study outlining 30 years of research on successful shallow foundations, done by the Norwegian Building Research Institute. Still, shallow foundations are not well known in Canada. The building departments that know enough about shallow foundations do allow them, as long as an engineer provides the design and stamps the plan.

There are situations where, even if you have the design, a shallow foundation is not appropriate. A shallow foundation will not give you a basement. Also, if the soil is not “solid and undisturbed” at shallow grade, you may have to dig deep regardless of how unlikely frost may be.

But in many instances, a shallow foundation will prove a safe, and inexpensive, option that deserves a serious look. **HB**

Writer Robert Koci of Toronto has 20 years experience as a carpenter, contractor and project manager.