



Notes from the Underground

June 1

Drain for Rain

When we first researched the site in August of 2008, we found a lovely wooded south-facing slope, populated here and there with mossy boulders. Seemed like a good place to find a leprechaun. A large oak tree dominated, with cedars, ash, basswood, and one lone white pine gathered around like courtiers. The topsoil was a sandy loam, perfect for good drainage.



And good drainage is the first requirement for an earth-sheltered house, as you can imagine. If you get the drainage wrong, you end up living in a damp basement, only good if you are a member of the mushroom family. Moisture was the number one problem mentioned by the owners of the earth-sheltered houses that we visited, so we were very aware of our drainage.

And, every indication was sand, so we didn't bother to dig a test hole.



In October of 2008, we started the first step of clearing the minimum of trees and the second step of digging into our perfect sandy soil. This is the hardest part, seeing a woods turned into a construction site. Luckily, it only

lasts until the house is built.

A metre down we hit disaster - clay. Getting water to drain through clay is like swimming in molasses. The water just stays there, and the clay becomes a gooey, sticky muckhole. Not where you want to live.

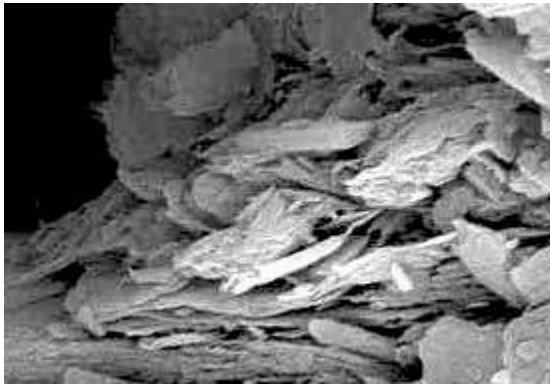
Soil is mostly composed of finely-ground rock particles, grouped according to size as sand, silt, and clay. Each size plays a significantly different role.



The largest particles, sand, determine aeration and drainage characteristics. The study of individual grains can even reveal historical information about their origin and manner of transport. Quartz sand that is recently weathered from granite or gneiss quartz crystals is angular. Called sharp sand in the building trade, it is preferred for concrete and in gardening where it is used as a soil amendment to loosen clay soils. In contrast, sand that is transported long

distances by water or wind will be rounded with characteristic abrasion patterns on the grains' surface. Desert sand is typically rounded.

The tiniest soil particles, sub-microscopic clay, chemically bind with water and plant nutrients to create a plastic texture. This accounts for the sticky goo in the spring and that bullet-proof slab in the summer. Clay is typically formed over long periods of time by the gradual chemical weathering of rocks by low concentrations of carbonic acid and other diluted solvents. In addition to the weathering process, some clay minerals are formed by hydrothermal activity.



Clay may be formed in place, but thick deposits usually are found as sediment after they have been eroded and transported from their original location. Although we think of beaches as sandy, clay is typically associated with large lake and marine deposits.

The ratio of the sizes determines soil type: clay, loam, clay-loam, silt-loam, and so on. Well, a metre down on our site, it was pretty much clay-clay.

Now, clay has many uses. You can write on it, build with it, smoke through it, and cook in it. You can use it to bulk up cattle feed and treat an upset stomach. But we weren't too happy to find it and, unless we wanted our own version of pottery barn, we had to do something about it.



A normal slab may have about 45 cm of crushed stone with 10 cm drains installed inside the footings, then the slab is poured on top of that.

We didn't want to take any chances. For our third step, we put down a layer of bubble-style insulating blanket (R 2) over the entire footprint of the house. Fourth was a 45 cm layer of crushed stone with 15 cm drains running through it. The insulating blanket kept moisture from soaking the stone from underneath and also prevented the stone from being pushed unevenly into the clay.

Fifth, we built the forms for the footings on this layer.



Sixth, we added another 45 cm layer of stone with 10 cm drains inside the footings before we poured them as the seventh step. Double drains for heavy rains was our motto. Also, more than double cost, thanks to clay, but we wanted to be absolutely watertight. That's one of the drawbacks of an earth-sheltered house, it is very site-specific. If you don't have just the right site, you have to make one.

Eighth, the rough-in plumbing was installed. Ninth, we laid down 7.5 cm sheets of high-density expanded polystyrene foam (EPS, R-12). Tenth, a vapour barrier of 6 ml polyethylene was carefully taped and sealed. The eleventh step was to cover everything with wire mesh, then the heating contractor came and wired the in-floor heating lines to the mesh for the twelfth step.



Thirteenth, the concrete was poured around and over the heating lines to make the final floor. Then, fourteenth, additional sheets of high-density EPS were laid in place for 2 metres out from the perimeter of the footings to prevent frost from moving horizontally underneath. Fifteenth, these sheets were covered with screening to prevent rock punctures. A final sixteenth step will be to replace the topsoil.

Sixteen steps for insulation and drainage so we won't have feet of clay.

By the way, this phrase "feet of clay" comes from the Old Testament (Dan.2:31-32). There the Hebrew captain Daniel interprets a dream for Nebuchadnezzar, founder of the new Babylonian Empire. Nebuchadnezzar had dreamed of a giant idol with golden head, silver arms and chest, brass thighs and body, and iron legs. Only the feet of this image, compounded of iron and potter's clay, weren't made wholly of metal. Daniel told Nebuchadnezzar that the clay feet of the figure made it vulnerable, that it prophesized the breaking apart of his empire. Over the years, readers of the Bible were struck with the phrase "feet of clay" in the story and it was used centuries ago to describe an unexpected flaw or vulnerable point in the character of a hero or any admired person (*Encyclopedia of Word and Phrase Origins* by Robert Hendrickson, Facts on File, New York, 1997).

If you are on clay, you may have a sump pump to remove excess water. Although these pumps are small, they can be big users of energy, especially in the spring. During power interruptions the pump doesn't run and that could mean a water disaster. Unfortunately, a battery or generator back-up just for a sump pump moves you even further from sustainability.

We do not need a pump because our drainage is now in place. Most new houses come with sump pumps as standard equipment, which allows the builder to ignore site selection and cheat on the drainage. A house that requires a sump pump is either built in the wrong place or built badly, and it should be a red flag when buying that house. It's another case of relying on energy-eating machines to do our thinking for us.

We are digging a garden, so I will soon post some tips about gardening on a clay goo-slab.

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