Build an earth-sheltered log cabin

By Tok Thompson

Over a period of three summers, for a total of five months, I designed and built an earth-sheltered, passive-solar cabin. The structure is 12x30 feet, with the main room being 12x20 feet. Besides the main room, I have an ample-sized bathroom and a "mud room" entryway. The cabin is sunny, comfy, and easy to heat. The total cost? Under $1,500.

In essence, the design is a sod igloo, perfected over thousands of years by northern-dwelling indigenous peoples. The main function of the earth-sheltered design for them was the heat efficiency. Whatever heat seeps out of an above-ground house is whisked away by the wind, but in an earth-sheltered dwelling it is kept next to the house, dramatically slowing the heat loss process.

For someone to build a similar house for a similar price would not be that difficult. Of course, I scrounged for building materials as much as possible. I purchased, for a mere $80 at a moving sale, enough metal roofing to entirely surround the cabin, along with a large front window set for $20. The window was initially too big for the hole, so I widened the space with a chain saw to make it fit. Lumber for the foundation, floor, and roof totaled $1100. I was able to barter for the use of a bulldozer, which otherwise would have been very expensive. Someone was throwing the front door away at a local dump, and they were only too happy to have it put to good use. Where I live, trees are free or freely given by neighbors, which is what prompted my use of them as my main building material.

The biggest problem with sod igloos is their tendency to leak water and, after leaking, to eventually rot. In fact, nowhere in all the literature on earth-sheltered construction did I find any log-based plans, which is due, I'm sure, to these very considerations. To counter the problems, I relied on modern technology, including surrounding the house in metal siding, and coating the outside of the logs in copper napthalmate. It is a noxious substance, but good at stopping rot. A more eco-friendly way would be the old Norwegian method of curing the logs in salt water, or just using driftwood. For additional insurance, I installed PVC pipe both inside and outside the house to drain any water down and out beneath the floor. I may have done more than minimally necessary to keep our house nice and dry, but I didn't want to take the chance that I might have to dig out the walls later for repairs!

I had cut and stripped all the logs the fall before, to give them a year to cure and dry. Preparing the logs was actually the most strenuous part of the process. It took me a month and a half of constant work, and along the way I learned a few things.

First of all, there are several ways to make sure the logs are cured. One way is to kill them while still standing by peeling off the bark all the way around the tree and waiting until they dry out before cutting them down. Another way, which is the one I used, is to cut them down, take off all the bark and branches, and prop them up off the ground to dry. Still easier, however, is to use trees which are already dead, especially those that are still standing. Around the area where I live there is a kind of tree beetle that will kill spruce trees without harming much of the wood. Since things rot so slowly in Alaska, these trees often stand for years, drying and curing naturally. Towards the end of my building project, I used some of these and was amazed at how easy it was to debark them.

If you decide to cut fresh trees and debark them as I originally did, however, be prepared for some work. Most log builders recommend using a drawknife, which has two handles, for stripping off the bark. For me, it proved easier to use my machete, which I could grip on both sides while wearing a glove, and which had the added benefit of a point for use in working on tough spots. The machete also made hacking off branches or other obstructions mercifully easier for me. The only other tools I used in this process were a chain saw and a log-turner.

Assuming you have the site and the trees, the first job in construction is digging the hole. Although a backhoe would be ideal, you can make do with a bulldozer, as I did. Digging the pit by hand, although possible, would be a monumental task. Before you dig, however, be certain the proposed pit is situated on the site exactly as you like it. For maximum sun, the front should be pointed south, although I chose to compromise between sunshine and the best view of the lake. A slight rise to the north is ideal, and be sure to have a good sand or gravel base.

Laying a foundation

There are several ways you could build a foundation for your cabin. Poured concrete or chemically treated beams seem to make the most sense for this project. The adventurous could forego this step and rely on treated logs. I chose treated 2x12 lumber, two thick, creating the net effect of 4x12 wood beams. After carefully leveling these, I lay thick Visquene (polyethylene) over them, to act as another moisture barrier between the house and the ground below, and then

built a subfloor of 2x6 lumber and CDX plywood.

I ran a 2x6 header board lengthwise along the house and nailed the 2x6 support joists into it. If I had been building the cabin any wider, 2x6 lumber would not have sufficed. As it was, I still placed several supports in the middle of the expanse. A viable alternative here would be a concrete floor, which would have the extra advantage of acting like a solar battery to trap the sun's heat during the day and radiate that heat back out at night. Personally, however, I prefer the look and feel of wood flooring.

Putting up log walls

When the subfloor was done, it was time for the logs. To move them to my building site, I used the bulldozer again, first pulling them with a chain, then using the blade to push them into the pit. One of the advantages of my underground design was that I didn't have to lift any logs. Although it was occasionally awkward to position them, this step was remarkably easy for me. Before pushing a log into the pit, be sure to plan ahead how you will roll it into place! If it is balanced just right, it is truly amazing how a person can maneuver even a 2x40 foot log with one hand.

Joining the logs together is a little like playing the guitar. You can do all right without knowing much, or you can spend a lifetime devoted to your craft. While the more you know and do will always show in the results, an airtight fit is simply not as necessary with an earth-sheltered design. The gaps between the logs can be filled with concrete (mixing it with sawdust gives it better flexibility) or store-bought log chinking (though this can be a bit pricey, if economy is an issue). Since most of the outside walls are covered with metal sheeting and buried underground, small gaps do not mean there will be holes into the outside air. More care should be taken with the few logs that will not be covered and buried, but by the time you get to those you should be getting the hang of log work. I recommend laying insulation between the logs, especially if you are not doing any elaborate fitting techniques.

My fast-and-easy approach consisted of cutting slices with a chain saw where the notches were to be, and then knocking them out with a sledge. When the next log was to be fitted on top, I would position it for the least amount of gap space, and occasionally I'd use the chain saw to improve the fit by removing bumps and other obstructions. It is also important to alternate the large and small ends of the logs or you will end up with one side of a house much higher than the other.

Roofing the cabin

This design includes a shed-style roof, which provides for maximum sun exposure and is, incidentally, very easy to build. To provide the slant, simply stop alternating the log ends and use the thicker ends exclusively toward the front of the cabin. The front wall thus becomes higher than the back wall. I began to build the slant about halfway up the wall although, in retrospect, I realize I could have used a bit more slope. Variations in the level at which you stop alternating will also depend, of course, on the shape of your logs. The more tapered they are, the longer you may wait to stop alternating log ends.

One of my prime motivating factors in choosing the shed roof design was the fact that winter was quickly approaching. Since this design involved lumber, it was the most expensive part of the house. There are alternative methods that would be cheaper, but they would also require much more skill than construction with lumber and plywood does. First, I placed a center beam across two walls so that it traversed the middle of the cabin and gave support to the roof. Then pairs of 2x6 boards were nailed together, much as when laying the floor, using two-foot spacing boards along two walls, and plywood was nailed over the top of them.

I laid aluminum roofing on top of that, as well as over the portion of the log walls that would be buried. I put insulation between the 2x6s from underneath and stapled Visquene underneath that. This, combined with sod and snow on top, provides excellent insulation.

A rather large front overhang is a good idea for two reasons. It keeps moisture away from that part of the front wall that is above ground. And it also cuts out hot summer sun, when the sun angle is high, while not interfering with the low-angle winter sun. The winter after I finished the roof, Alaska had the heaviest snowfall in 50 years and many buildings in the area collapsed, but my cabin pulled through just fine and I never had to shovel the roof the entire time. After that, I felt more confident about my little igloo.

As I mentioned earlier, this roofing method was easy but a bit expensive. A cheaper alternative might be pole roofing, with the poles covered first by chicken wire and then by concrete, which could be water-sealed. I was looking at this method when the imminent snowfall forced my decision.

The finishing touches

The next summer I returned from a honeymoon trip up the Alcan highway, and my bride Katie valiantly joined the project, helping me put aluminum siding along the sides of the cabin and fill in the pit with gravel. After those two jobs were done, all that was left were the little things—moving in a Franklin stove, installing windows, doors, floorboards, and so on.

It's been hard work, lots of fun, and in some ways a dream come true. Future plans include a full-service bathroom with hot and cold running water and a combination solar- and

steam-powered electrical system. I have the plans now, and will write more later to let you know how they work out! Δ