

## Semi-underground, solar house near the Canadian border has some ideas worth crowing about

By Don Fallick

I live in a five-bedroom, two story, semi-underground, passive solar house, with a 12-volt solar electric system and gravity flow plumbing. We use propane for cooking, for refrigeration, and for back-up lighting in the winter. We also use kerosene lights in winter.

Because we are in the bottom of a canyon near the Canadian border, we don't get much solar heat in December and January, so we supplement with a wood-fired cookstove. The house was designed for thermal efficiency, and is so well insulated that even when the temperature falls into the minus numbers for weeks at a time, we still have to let the fire go out in the daytime to keep from roasting. Yet this house was designed and built entirely by two bachelors without any construction experience!

### Getting recycled materials

Tom and Ken decided right at the beginning that they were going to use recycled materials as much as possible, so they began by taking down several old houses and a barn for the materials. If you live in the country, you can nearly always find old buildings that need to be demolished.

It's best to get some kind of written agreement with the owner, specifying when the work is to be completed and exactly what is to be removed. One friend of mine got into a big squabble with a barn owner who insisted that he also remove the foundation, a very expensive proposition.

Besides being an inexpensive way to get building materials, recycling houses is an excellent way to learn how they are put together. If you can't get

an experienced helper to show you the ropes, here are a few guidelines:

### Some salvaging tips

- 1. Pay a lot of attention to safety and use protective equipment. A 50-cent used hard hat once saved my life, but that's another story. Wear a respirator when working with plaster or drywall, and keep naily wood away from your work area.
- 2. Better yet, keep nails picked up, and de-nail wood as you go. That way, you won't end up with a mountain of naily wood at the end. It's never a good idea to transport naily wood, and in some places it's illegal.
- 3. Demolish a house in the reverse order that it was built. First remove all interior fixtures, doors, trim, floor coverings, and flooring, but leave the subfloors. Then remove interior wall surfaces. This way you don't wreck anything with plaster dust. Remove and dispose of insulation. Then start at the peak of the roof and strip the house right down
- 4. Clean up well. A good cleanup job gets you recommendations. It's the price you pay for the building materials. It beats paying money doesn't it?
- 5. It takes about three recycled houses to make enough materials to build one average sized house.

### Start night with a good foundation

A good foundation is usually the largest single expense in building a house, especially if the rest of the house is recycled. Tom and Ken economized as much as possible, but their foundation still cost more than the rest of the house. Stiff, it was a good investment.



A house with a poor foundation will give you nothing but trouble as long as it stands. Doors and windows will stick, walls will let in drafts, the roof will leak, the floor will not be level, tables and chairs will all wobble, linoleum or tile floors will crack, etc. And difficult and expensive as it may be to build your foundation right, it's even more difficult and expensive to fix it with a house sitting on it!

### **An insulated foundation**

Tom and Ken decided on a slab foundation, but insulated it from the ground with two inches of foam board underneath. Tom's idea was to let sunlight coming in through the large, south windows heat the concrete, then use it as a thermal mass, to heat the rest of the house. It works, too.

When my family lived in Wisconsin, we tried a different tack. We dug down to the constant temperature zone and built a bottomless box of cement blocks. This we filled with rocks and insulated from the surrounding earth on the sides only, with two inches of foam boards. Then we poured a slab on top of the rocks and built a conventional structure above the slab.

The idea was to conduct the constant temperature zone up the slab floor. This temperature was about 45 degrees, which is a bit cool. On the other hand, we never had to raise the air temperature in the house more than 20 degrees, which takes very little fuel.

My experience is that both approaches work well. I prefer the way we did it in Wisconsin, but not enough to go to the trouble and expense of building another house!

If you are considering a slab foundation, it will pay you to get the grounds tested for Radon gas before you build, or maybe even before you buy the property. It's difficult and expensive to keep Radon gas out of a slab foundation house. And even more expensive to let it in.

### **First floor of barn beams and cement blocks**

The walls of the lower portion of my house are essentially those of a traditional basement, minus one side. The south wall is almost all glass, supported by massive posts every 10 feet. The posts are made from 6x9 barn beams, which support a sill of similar dimensions, on which the second story is built.

The other three walls are of cement blocks, stacked up like brickwork, but without mortar, and secured by plastering inside and out with ShurWall, a surface-bonding cement.

This technique is so simple that just about anyone can do it. It's best to stack the corners first, so you can check them for square and level. To square the corners, make sure that opposite sides are exactly the same length, and that diagonals between opposite corners agree to within 1/8 inch. You can do this by stretching strings from corner to corner.

While you're at it, check the level with a line level. When everything is right, mix up some of the cement and plaster the corners, making sure they stay square and level.

Leave half a block unplastered where the rest of the wall will be, so you'll have something to plaster it to. When the corners are dry and firm, fill in the walls, checking for flatness with a long, straight board as you go. Any spaces between blocks can be filled up with whatever is handy. The cement contains glass fibers and will eat your skin alive. We use rubber gloves to protect our hands, covered by cheap, cotton work gloves, to protect the rubber gloves from the blocks. You end up with a wall that looks like it's been rough-plastered.

If you're good enough, you can finish plastering it with regular plaster, paint it, or cover it with anything that'll stick to cement. You can nail into it with masonry nails, or glue paneling on with Liquid Nails or other construction adhesives. I like it.

### **Thermal windows**

For the long south wall, Tom and Ken used large sheets of glass, doubled to make homemade "thermal" windows. I suspect it was recycled too. It could have come from a store front. Tom cut spacers 3/4 inch thick, painted them and installed the glass when the weather was dry. That was 10 years ago. As I write this, it's 6 degrees F outside and the windows haven't frosted or fogged up at all.

### **"Conventional" construction**

Inside dimensions at the top of the block walls are about 20 feet by 40 feet. To avoid the necessity of finding 22-foot long floor joists to span the lower room, Tom and Ken used 4x12 barn beams every 10 feet. The ends rest on posts right next to the ones holding up the south wall. They accented this massive, post-and-beam look by staining the woodwork dark brown and painting the walls and ceiling light colors.

Post and beam is one of the oldest and strongest construction methods known. It is little used in the USA today because of the expense, but if you're using recycled materials, this hardly matters. By doing this, Tom was able to use 10-foot long floor joists for the second story. This is important, because 12-foot long joists are common in old houses, but frequently the ends are spoiled. Planning for shorter joists allowed Tom to cut off the bad ends and salvage the good parts.

The walls and roof are mostly "conventional construction". That is, studs with diagonal bracing, fiberglass insulation between the studs, siding on the outside, vapor barrier on the inside, covered by paneling or drywall. A truss roof and metal roofing complete the house.

Over the years, carpenters have discovered ways of building that produce a strong, inexpensive structure with the least possible amount of labor. They may also be unesthetic, uneco-

logical, and thermally inefficient. The trick is to change the second set of characteristics without changing the first.

### **Thermal efficiency**

Tom and Ken wanted greater thermal efficiency, so they increased the thickness of the walls and used more insulation. A one-story dwelling, which this in effect is, needs 2x4 studs, set 16 inches on center. Tom used 2x6 studs 20 inches on center, and maintained the same strength, while leaving room for more insulation. Doing this uses more wood, however. If your wood is recycled, this is unimportant. The thicker, wider insulation will cost more, but will save money in heating costs in the end.

Quite a bit of the studding in typical walls is not there to add strength, but merely to provide a surface to nail other components to. For example, if you're planning to use drywall as an interior surface, you need to have a stud centered right where the edge of the drywall panel is going to fall, so there will be something firm to fasten it to.

### **Barnwood**

Since Tom and Ken had plenty of barn wood, they decided to use it for interior paneling, instead of buying drywall. And since barnwood is stiff, they decided they could cut it to any convenient length and nail it to any convenient stud.

So they built the corners of their walls as simple posts, without any complicated nailers. When it came time to finish the inner surfaces of the walls, they just covered one wall at a time with barn boards, from corner post to corner post. Of course, when they came to the next wall, there was no post or stud at the corner that they could nail to. So they just nailed the barn boards to the next closest stud, and secured the ends, of the barn boards by toenailing them into" the

first wall. I would never have known this if I hadn't decided to remodel one of the rooms.

My 13-year old daughter complained that the barn wood was impossible to keep, clean and didn't look feminine. I determined to finish her room with drywall, and bigger windows while I was at it. I could have simply drywalled over the barn wood, but since I had to remove it to enlarge the window openings, I removed all of it. Since there was nothing to nail drywall to in any of the corners, I had to rebuild two exterior walls before I could install the windows or the drywall.

It was then that I discovered that the northern 1/3 of her room has no foundation at all under it! Just a couple of cement blocks under the corners. This hasn't affected the floor in Katey's room-yet. The huge barn beams Tom used for fills are stout enough to act as a sort of cantilever construction. But it does explain why the upstairs door frame changes shape every winter, necessitating a 1½ inch thick door molding/weatherstripping to keep out the drafts, and requiring me to move the strike plate twice a year to enable the doorlock to latch.

Apparently, the whole north end of the upstairs was an afterthought. Now I've got a 12-year old who wants her room remodeled too. This time I'm going to leave the barnwood in place!

### **A wiring afterthought**

This does bring up one problem with owner-built houses. If you sell your house to someone else, or even change your mind later, doing things in an unconventional manner can cause problems. Tom and Ken are both devotees of kerosene light, so when they built their house, they didn't put in any wiring, or even make it easy to add later.

Eventually Tom married, and decided to add a 12-volt electric system, but there was no place to put the wires, so he surface-mounted them. In the two

years we've lived here, I've been gradually finding ways to run\* wires through walls. In one case, I furred out a wall with 2x4s and actually built a new wall around the wires. I still haven't got 'em all. In rebuilding some of the walls to add openable windows (there were only two in the whole house) I've run lengths of black plastic irrigation pipe through the studs just so I'll have an easy way to run wires later. It's cheap, it's easy, and it's safer than trying to hide wires under kick molding.

### **The building in-"spectre"**

Preventing problems like these is one of the duties of that "bogeyman", the Building Inspector. To discourage graft, the courts have held that a building inspector may be liable for damages caused by the failure of any structure he OKs, even 20 or 30 years later! As a direct result, building inspectors are very conservative people. Only by proving to a court that everything he accepted was standard practice, or required by Code, can a building inspector clear himself in the event of a disaster, and be assured he won't lose his retirement just because you wanted to be different.

You can turn this to your advantage if you are an inexperienced builder by asking the inspector to pre-approve your drawings. These need not be architect quality blueprints, just legible sketches with dimensions shown. The inspector is not legally allowed to tell you how to build your home, but if you bring him (or her) drawings to criticize, most any inspector will be glad to tell you what's wrong with them, after all, that's his job.

When he finally does approve, get the drawings initialed. This can save you untold grief if you have to change inspectors before the project is finished, for some reason. I once had to rip out and rebuild two walls to please a temporary inspector while the first one was away on a two-week vacation, or else sit idle for two weeks till

he came back, just because he hadn't initialed the drawings. Besides, you'll learn an awful lot. I've yet to meet an inspector who didn't have a fund of "horror" stories from his experience with supposedly knowledgeable building contractors.

Your attitude can make or break you. Approach an inspector with a chip on your shoulder, and cold shoulder is all you're likely to get. Respect will get you a lot farther. It also helps to do your homework first, so you'll know the right words to use. Calling a stud a "post", or a joist a "rail" will only decrease his confidence in you, especially if you are asking him to risk his life's savings on your own, brilliant, but untried, idea. Time/Life Books has an excellent series of books covering just about every aspect of home construction, with terrific illustrations. If you're interested in less conventional structures, *Vie Owner Buift Home*, by Ken Kern is tops. There are lots of others. Tom and Ken, who built my house, didn't read up on the subject first and didn't have to please a building inspector. The result is that my house has some unusual features.

### Some unusual features

The downstairs portion of my house is a "great room" containing the cooking, dining, bathing, and living areas. It looks out through a south wall made almost entirely of glass onto a sunken, terraced garden. Light from the afternoon sun in winter penetrates to the furthest corners of the room.

There is cross light from a small, high "basement window" over the sink. This lets in light but no view. The south wall lets in light and a gorgeous view, but is still completely private. We can't even hear traffic on the private road less than 30 feet away.

Roughly centered in the opposite wall is a double-wide, recycled-brick chimney. Our wood range uses one of the two flues. The other was originally intended for a sauna on the other side

of the wall. The sauna was built and paneled with cedar, but proved impractical. Too much heat leaked into the rest of the house. So we have a beautiful, cedar-lined, walk-in closet in the middle of our living room, and an extra flue.

Since Tom and Ken already had a legal outhouse, they decided to avoid the expense of a septic system by not installing a toilet. Rather than building a separate room just for the bath tub, they quite logically put it in the kitchen. There, its proximity to the sink and the stove-fired hot water tank make for very short pipe runs.

### A ladder to the bathtub

Now the floor of the great room is eight feet below grade (ground level). To avoid having to dig a trench ten feet deep through rocky soil for the drain pipe, they placed the pipe at the minimum depth possible. So our sink is at a comfortable height for six-footers, and the top of the bath tub is more than four feet high and must be reached by a ladder. Standing up for a shower is impossible, even for my fivefoot wife. We have four drawers for towels and such below the tub. And we have had to enforce a firm rule that it is NOT OK to steal the ladder while your sister is in the tub!

Another unusual feature are the five large holes in the ceiling downstairs. This is the only way to get heat to the five bedrooms upstairs. Cold air returns down the stairway. Ordinarily, this would create breezes across the floor, but the stove is less than five feet away from the stairway, so the cold air doesn't have far to travel before getting recycled into hot air. In winter, the bedrooms are almost always cooler than the downstairs living area, but we like it that way. I have had to make or find grates for the upstairs holes in the floor. The one in the bedroom shared by my four-year-old and ten-year-old daughters is always getting kicked out of the way and toys falling through onto the

kitchen table below. I keep meaning to fix that.

Heat is provided by a huge, black cookstove with a top nearly the size of a double bed, that sits in the center of the great room. It's oven is two feet square by a foot and a half high, and can bake a 23-pound turkey, two pumpkin pies, and three or four squash simultaneously with room left over. For real. We did it one Thanksgiving.

The firebox is over two feet long and will accept a five-inch diameter log, even with the water pipes in the firebox. We never wanted it. My wife Jj guessed rightly that it would take an hour of stoking before giving back any useful heat. We already had a stove of our own, but Tom was insistent, finally cutting the price of the stove down to less than one half of its reasonable value.

It later transpired that, of the six strong men who had helped Tom carry the stove down (in pieces), not one was willing to help him carry it back

#### Thwack

*He doesn't chunk rocks  
at trees any more.*

*He used to.*

*But he was walking  
down the road*

*one day*

*watching his feet  
and he picked up  
a neat, jagged rock  
whose corners just fit  
where his knuckles bent,  
and he chunked it*

*like a fast ball  
at a tall alder.*

*When that rock went  
thwack!*

*he felt a pain*

*like a fist in his gut.*

*So he told the alder  
he was sorry*

*and he doesn't  
chunk rocks at trees  
any more.*

Cathleen Freshwater Thomsen  
Manzanita, OR

up. Now that we have a propane stove to cook on, Jj has started agitating for a real heat stove to replace Iron Annie and free up 20 or 30 square feet of floor space in the living room.

Since moving the stove outdoors will require me to temporarily remove the patio doors in the south wall, it's not likely to happen before Spring. But I think I've figured out how to do it. Δ