How to Build a Greenhouse from Used Windows or Storm Doors

By Nevin Hawlman

Early that autumn morning, I knew it was going to be a great day: I dropped my toast, and it landed honey-side up! Then in the morning newspaper, I saw an announcement for a public auction of "dozens of used aluminum storm doors." I could hardly wait to hitch up my trailer.

My bid was $4 when the auctioneer said, "Sold! How many do you want?"

"All of them," I said. I went home with 25 used double-track aluminum storm doors with screens and tempered glass.

Building the Greenhouse

I always wanted a home garden greenhouse to start my own vegetable plants (and a warm place to putter as the snow swirled outside). When I announced my new project at our Sunday family supper, my son smiled as he said, "I thought you were running low on things to do." The next day he was helping me unload stones for the greenhouse base.

We made the greenhouse frame from 2-by-6s. The studs and rafters are on 36-inch centers to accommodate the 36-inch storm doors. Top and bottom plates are double 2-by-6s with overlapping corners. The frame is held together by three-eighths-inch bolts and galvanized spiral nails. The north side has no glass exposure. It is sheathed with oriented strand board and covered with vinyl siding. It shelters the greenhouse from cold winter winds. That sheltered side also makes working in the greenhouse bearable on hot summer days. The worktable is in the shade.

Heating the Greenhouse

The greenhouse is heated by hot water piped in via underground lines coming from a woodstove outside my shop. I modified the stove by laying a cast-iron radiator on top of it. The water in the radiator is drawn to the greenhouse radiator by a small circulating pump. The pump runs constantly in cold months. The greenhouse thermostat controls the blower on the remote woodstove so it maintains a water temperature of about 120 degrees Fahrenheit. I think this is more efficient than having the water temperature fluctuate widely. I know it provides a more even temperature in the greenhouse, which ranges from 70 to 80 degrees on cloudy days.

If you love gardening and potting plants, build a greenhouse! Don't expect it to pay for itself unless you value the excitement of seeing a seed sprout, you get a special satisfaction from eating your own harvest, and enjoy the flavors that have been lost in the

quest for commercial produce that stays hard as wood in shipping (and also resembles wood in flavor).

Remember; your first greenhouse can be anything from a recycled flea-market fish aquarium to a heated walk-in model. Whatever style you choose, you will surely enjoy it.

For Less Than $35K, We Built Our Own Home

By Bill Hakanson

Since *Mother Earth News* was first published back in 1970, we've dreamed of improving the quality of our lives and being self-sufficient. And after spending most of our careers in the city, we finally got our chance in 2005 when 13 acres in northwest Pennsylvania — 10 of which were once part of a cornfield — came our way.

Our first challenge was to erect a building we could live in during the spring, summer and fall, and store our garden equipment in during the winter months. Eventually we expect to live in Pennsylvania year-round, but for now we enjoy exploring the South during the winters, leaving Pennsylvania after the harvest and returning in time for spring planting.

The corrugated arch-style building that we used is based on a British design dating back to World War I. In the United States, this style building was first manufactured on Quonset Point in Rhode Island during World War II in response to the need for lightweight, portable buildings that could be assembled without skilled labor.

The source of our 40-foot-by-40-foot building was SteelMaster, a company founded in 1982. Our building, an S Model, was manufactured out of 22-gauge Galvalume steel. One of the features I like about this type of building is the absence of posts and beams. The corrugated, arched wall design is self-supporting. The result is one large 40-foot-by-40-foot open square with an 18-foot peak.

To withstand wind and weather and secure the 30-year warranty, these steel buildings must be attached to the earth, either by narrow concrete footers along the base of both sides of the structure, block or wood walls erected to support the structure, or a concrete slab the full width and length of the building.

We chose to install a full slab featuring an 8-inch-by-12-inch perimeter concrete beam. This is called a "floating" slab, as it sits on a foot of gravel. Our building is situated on a slope, so water can escape from under the concrete slab should any get underneath. Inside the perimeter beam, the concrete is the standard 6 inches thick. SteelMaster provides approved engineering drawings customized to your needs, and they research and ensure compliance with all applicable codes.

Putting up the House

The components of the building were delivered on three pallets. Looking at the small load, I couldn't believe it was all there: Not counting the end walls, the arched structure involved bolting together 160 panels, each approximately 2-feet-by-8-feet in size. More than 3,000 nuts and bolts were required.

I originally thought I would erect the building myself, with the help of friends who volunteered. I quickly realized this project would take a more concentrated effort. Under a move-out/move-in deadline, I doubted I could meet my schedule with a weekend-warrior workforce.

The dedicated workforce was the critical component in my decision to hire a contractor. The other construction requirements included a scaffolding system and a cordless, rechargeable, electric impact drill. I was fortunate to find a local company that had experience erecting a Quonset-style building. Even then, erecting the shell took a three-man crew two weeks to complete. That's 240 labor hours.

The building I purchased included three sides. The fourth side, made of wood, was erected by an Amish contractor. His construction crew completed the job for two-thirds of what the other contractor wanted. It took the three-man Amish crew four days to finish the south wall, including installing the windows and doors.

This south wall includes seven 3-foot-by-6-foot double-hung windows, a double door, a single door, and a 2-foot-by-3-foot office window. The large windows provide passive solar warmth in the interior space and heat the concrete slab. To supplement the passive solar heating elements, we installed radiant heat in the concrete floor and a super-efficient Vogelzang Durango woodstove, which we keep burning constantly once the outside temperature drops below 40 degrees Fahrenheit. The wood we cut to build the driveway sure came in handy!

We added much more than just the south-facing exterior wall. The entire south-end addition included the interior load-bearing wall, the stairs, the second floor, the electrical wiring, the plumbing, kitchen cabinet and countertop installations, exterior decks, and lots of other interior and exterior work.

Most of this work I have done myself, with occasional help when needed. The help I receive from my brother Duane has been a big bonus. He lives nearby, and he's spent most of his career in the construction business. His skills and knowledge of construction techniques have been invaluable. One of my favorite Duane tips before starting a new project is: "Don't be scared." That's a good motto for anyone attempting a project they've never done before!

In my opinion, the finishing work done in American construction can be overly expensive and time consuming. One way to minimize this is to apply an open joist system for the second floor. While I like the look of the open joists, they're not intended to be left exposed, as they're "rough" cut, with excess glue and machine cutting marks exposed. To improve the look, I sprayed a diluted drywall compound onto all visible joist surfaces, and finished by spraying white paint over the joint compound.

Water Matters

The next big issues were water and sewage. My research included visits to the county water resources department and talks with neighbors. Most folks have deep wells or springs. Some have both. Even though we get about 40 inches of rain each year, lots of folks around here have water problems during dry spells, and supplement their water needs with tanks carried in the backs of their pickup trucks, or with water deliveries from companies such as Culligan.

This discovery led me to the idea of capturing rain in a cistern and using it for non-potable purposes — the building was even designed with drip lips at the slab level. Once our metal building was up, I was amazed at how much rainwater could be captured! One square foot of rain, 1-inch deep, provides .625 gallons of water. That might not sound like much by itself, but it translates to 40,000 gallons of water per year that falls on our building.

We also installed rain gutters at the ground level of the building. That water is channeled through pipes into a 1,000-gallon concrete cistern buried underground. A shallow-well jet pump brings the water into the house from the cistern and feeds it into the PVC plumbing system for the kitchen and bathroom. While I think it may be possible to purify the cistern water to make it potable, at this time we purchase treated water for cooking and drinking.

I estimate that using the cistern saved us about $1,500 versus drilling a deep well. And from what I hear, the water quality is about the same.

On the sewage side of the equation, we installed a BioLet composting toilet, reducing water usage substantially. The BioLet 20 Deluxe, designed in Sweden, uses a nominal amount of electricity to power a fan and heater that aid the decomposition process. In the near future, we expect to invest in a solar panel to power the toilet, which the company offers. In addition, we distribute graywater to the fruit and nut trees next to our home through a system of underground pipes.

The local approach to wastewater handling is a sand mound. While we retain the option to install one of these later, we've saved nearly $15,000 with our approach.

Food to Live On

During last summer's stay at the farm, we tripled the size of our garden, adding 50 blueberry and raspberry bushes, 13 beds for beans, pumpkins and asparagus, a two-bin composter, and a few fruit and nut trees. We've also added a "food room" to the house for the freezer and for storing canned food and other items that may be damaged by freezing. This is the only room we'll need to heat during the winter while we're away. It's fully insulated and includes a small, electric baseboard heater.

Wanting to get a jump on spring planting, we recently installed a movable greenhouse/cold frame. We'll start temperature-sensitive plants such as tomatoes, peppers and eggplant in the ground under the greenhouse cover. Then, when the threat of frost has passed, we'll slide the greenhouse away to expose the plants to full sun and weather. In the fall, the greenhouse will extend the growing season into the colder months. We expect the movable greenhouse to provide a total of 12 extra weeks of production, six in both spring and fall.

To address our meat (and egg!) needs, we'll invest in chickens. We'll give them a restricted free range during the summer, and then butcher them in the fall. They'll be

frozen, canned or eaten. When we live here full time, we'll sustain a flock of chickens year-round.

This is a pay-as-you-go project, and we've kept costs to a minimum. We explore all options before spending. We will have no debt related to the farmstead, and expect to generate some income from our labors through the sale of our excess crops, shiitake mushrooms and honey.

For us, the future is now. We're active, growing our own food, and we're much healthier for it.

Build a Home for $10,000 in 10 Days!

By Chris McClellan

For half a century, William Castle has been building bridges, cabins and shanties of all shapes and sizes. His favorite projects are right in his own yard. Woodland areas such as that of his native Belmont, N.Y., often have an abundance of "junk" timber that has little commercial value because of its small diameter, twisted grain or other imperfections. The modified timber-framing method Castle has developed lets him quickly and easily turn this low-cost, local resource into beautiful houses, such as his daughter's cabin (see the Image Gallery). The shell of the 1,000-square-foot house was built over an existing foundation by a crew of three to four adults and two children in less than 10 days — for less than $10,000!

If You Build It …

Thirty years ago "Pollywogg Hollër," as Bill and Barb Castle call their 30 acres surrounded by forest, began as a project to bring the family together. Bill had his own bridge building company, a seven-day-a-week work ethic and almost no connection to his growing children.

At Barb's insistence, Bill began taking time off, and over the course of three summers, they and their three teenage children built a 20-foot-by-30-foot log cabin in their back woods. They dug the well and foundation by hand, dragged logs out of the woods with an old tractor, peeled the logs with a drawknife and placed them with the help of a homemade crane.

Other than mortar, hardware and roofing, all the materials in that cabin came from the land. Over time it became their home. Now, it's a rustic bed and breakfast "eco-retreat" that they run with their son Mikael — complete with solar power, a sauna, bathhouse, picnic pavilion, wine bar and wood-fired pizza oven. There's even a stage for weddings and concerts. Most importantly, that cabin brought their family together.

As we walk through the enchanted village Castle has built, he points out the different local woods and the uses he puts them to: There are footbridges of larch (aka tamarack), which he calls “the poor man’s cedar.” Fence posts are rot-resistant black locust. Hemlock is used for sheathing; red oak, for floors; and fir, for log cabin walls.

Castle has used cedar for roof shakes in the past, but sustainably harvested cedar is getting harder to find at any price. These days Castle prefers to build low maintenance metal roofs or “living roofs” with a rubber membrane covered with moss and wildflowers.

A Simpler Timber-framing Technique

Castle’s building technique has evolved to allow him to do more with less. Hand building a log cabin over three summers is a great way to spend quality time with your children, but the process uses more time and material than timber framing a similar space. Also, while Castle prefers to work with round timber, the natural curves and variations in tree formation that give round pole construction its beauty also make it difficult and time consuming, with complex cutting and matching. So using low-cost material only partially makes up for the extra effort.

Many timber framers mill timbers flat and square on all sides. Timbers trimmed square and straight are easier to work with, especially when it comes to cutting joints or attaching sheathing to the outside of the timber frame. The downside is that square-timber framing usually requires expensive woods, such as white oak, that are dimensionally stable and don’t tend to twist as they dry.

Castle has found a compromise that gives him the benefits of both techniques — a kind of “three-quarter-round timber frame.” He simplifies his cutting and fitting by milling one or two sides of each log flat, but he leaves the other sides “in the round,” which keeps the wood stronger and less likely to twist. This allows him to use smaller trees of non-premium species, even with minimal drying.

A three-quarter-round timber-frame is assembled with flat sides of the wood facing out, making it easy to square and plumb the sides of the building. Milling only the surfaces of the wood that will be covered by the building sheathing also saves one-half to three-quarters of the milling time, while retaining the rustic beauty of the round wood where you can see it on the interior walls.

The system of joinery Castle has developed to work with his three-quarter-round timbers is quick, easy and forgiving. He starts by squaring the round wood at the location of the joint with a radial arm saw and a chisel. A chain saw will do the job a lot quicker, but the visual quality of the joint suffers.

Squaring the timber at the joints makes it easier to lay out cross pieces and knee braces. The resulting edge between the round and square portions of the timber also wedges the wood together in a way that adds strength to the joint. The connection is secured by

countersinking one or two half-inch lag screws through the “meat” of both timbers. (See the Image Gallery.)

The flat surfaces of the three-quarter-round timber frame also make it easier to attach sheathing and roofing with a minimum of cutting and fitting. Castle usually sheathes his buildings with a “sandwich” of rough-sawn boards around a core of 2 inches to 4 inches of foam insulation, making these buildings extremely tight and well-insulated. (See Castle House Diagram.)

More Tips for the Technique

It is worth noting that designing a building on a 4-foot-by-8-foot module (open space between timbers of 4-feet-by-8-feet on center) has a number of benefits. First, the timber frame will cover most, if not all, of the joints if you choose to use drywall as the interior layer of your sheathing sandwich, saving time in the finishing process. The drywall even can be painted before it is hung, with no taping or masking!

Not one to waste anything, Castle’s workshop is actually sheathed with “log siding” made from the cut-offs or “slab wood” left over from milling the frame and interior sheathing for the building.

The wood in all of Castle’s buildings was selectively cut from his property or within a few miles. Compared to clear-cutting the forests of Canada and trucking in the lumber, local wood has a significantly smaller ecological footprint. The practice also supports the local economy.

If you use a lot of wood like Castle does, it can even make sense to purchase your own mill. Because Castle also carves large tables from single slabs of wood, he has a custom-made mill that can turn a 5-foot-diameter tree into lumber.

The Castle family has built two houses and a wood shop using Castle’s three-quarter round timber frame method. It took a small crew a little under 10 days to rough in each building. And each of these house shells was completed for less than $10,000, which comes out to about $10 per square foot!

Using the same technique, Castle and a helper are building a workshop where he can build his trademark rustic furniture. Construction has been more time consuming, as the workshop is something of a showpiece with more fancy joinery in the stairs and porches, but even with temporary Styrofoam doors it is easily heated with a small, electric space heater.

But it may be a while before Castle gets back to his furniture: Before he disappears into the workshop, he has promised his wife a retirement cabin built along the same lines.