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White Earth Cordwood Project

By Richard and Becky Flatau

In September of 2008 the Midwest Minnesota Community Development Corporation contacted us with the possibility of building a cordwood home on the White Earth Reservation in northwest Minnesota. The idea was to provide attractive, affordable, and energy-efficient housing on the reservation, while offering employment opportunities through the training of tribal cordwood masons.

The plan to work with the White Earth Tribal Council allowed the home to be constructed on Ojibwa Tribal Trust Land. The local contractor and members of the tribe were enthusiastic about building a home that would stand in harmony with the natural surroundings and use locally available resources while keeping energy consumption to a minimum. Using tribal labor and tribal supervision was very important. And having a member of the tribe purchase the home was further inspiring.

It would be designed and built with wood from the area and in accord with Ojibwa home traditions. That is, the house would be a multigenerational home, it would incorporate a large family gathering area, the entrance would face east, and it would be composed mostly of renewable materials.

An architectural firm was hired to coordinate and include energy-efficient and best-practice construction methods. After drawing preliminary plans, there were many discussions and consultations, and the plans were modified to meet the specific needs of the owner. Included was an "energy heel" attic truss, which conserved heat and added 800 square feet of living space upstairs. The result produced a three-bedroom, two-bath, 1,840-square-foot home featuring a large open kitchen/dining/living area directly beyond the entry.

Combining Tradition and Technology

We were fortunate to work with two very capable builders, the general contractor Robert Zahorski, and Bill Paulson, a tribal member who was the project coordinator. Each dovetailed into the other's strengths, the result being a structure that evokes Ojibwa traditions yet uses 21st century construction techniques.

Tribal traditions blend with cordwood techniques in this contemporary energy-efficient home.

There are Ojibwa design features mortared into the cordwood walls, and tribal members were hired and trained as mortaring crews. Quite deliberately, northern white cedar—a sacred tree in Ojibwa culture—was used for the post-and-beam framework, and the same wood was used as log ends to construct the 16"-thick cordwood walls.

The owner, an Ojibwa tribal member and a teacher on the reservation, furnished plenty of input, which resulted in the use of truly functional space and a more efficient design overall. The building's steep 12/12 pitch roof allowed for two bedrooms and a bath in the "found" space upstairs.

Some of the higher-tech features particular to a home in this cold climate include an insulated thermal storage bed with radiant in-floor heat (coupled with off-peak power usage), high R-value foam insulation in the log walls' center cavities, and cold weather mortaring techniques necessary for the integrity of the mortar bond.

Sand Bed Thermal Storage

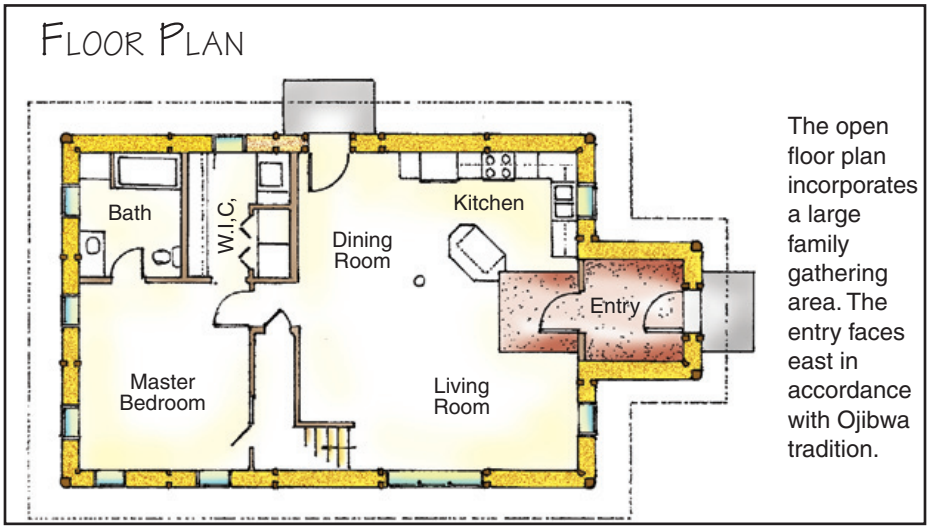
Construction began in the fall of 2009. In a region where annual heating degree day figures come in over 10,000, a bit of extra investment in thermal management is well worth the initial cost. So, the foundation was built with an insulated sand bed installed beneath an insulated cement slab. This high-mass sand bed stores boiler-fired hydronic heat during off-peak energy hours and then radiates it throughout the house during the high-energy-rate daylight hours. The concept is similar to that of radiant-floor heating, in that the sand bed under the foundation is insulated from the surrounding soil. The difference is that it also provides heat energy storage for the home.

Cedar Post-and-Beam Framework

After the foundation was complete, the framework was built. The home's load-bearing post-and-beam frame was erected by a local contractor. Cedar posts harvested from near the reservation were milled on the two sides that would abut the cordwood infill. They were left rounded on the interior and exterior faces for appearance's sake.

During construction, sturdy diagonal bracing was used to maintain structural integrity and prevent sections from going out of square. These braces are removed only after the cordwood walls approach the 4' mark and can provide support in themselves.

With cordwood construction, it is typical to have the roof finished and shingled before actual cordwood infilling begins, which allows the cordwood mortaring to take place for the most part out of the elements. If a section is not finished before the arrival of freezing weather, it can be temporarily sheathed in plywood for the winter and work can continue on the inside of the building. A completed roof system also provides fascia boards to which tarps can be attached—very helpful when it's necessary to protect the mortar and the workers from the drying rays of the sun.



The open floor plan incorporates a large family gathering area. The entry faces east in accordance with Ojibwa tradition.

Options in Electrical Wiring

The presence of wet alkaline mortar during the construction process is something of a fly in the ointment to conventional building codes. However, there are still several code-compliant ways to run electrical wiring in a cordwood building. In general, we recommend that you follow local building codes. With cordwood buildings in various parts of the country, we have used EMT conduit, Romex NM, and UL 12-2 wiring wire-stapled to the middle of the posts.

In the case of the White Earth home, the electrical contractor chose to run flexible plastic tubes (also called flexible PVC conduit or "blue smurf"). In accord with the blueprint, the wiring tubes were installed throughout the building. Frankly, the hanging blue tubes with their metal receptacles were very irritating to work around during construction, and the masons were constantly bumping into them while mortaring.

Structural Window Boxes

Window boxes, in cordwood terms, are not planters hung off the front sashes. Instead, they are a sturdy framework (here made of doubled 2 x 8s) fastened to the building's stout top plates. The two exterior door frames are also roughed-in in a similar manner, tied to the upper framework of the house with header cripples.

It's important that the window boxes and door framing be secured like this to prevent racking, twisting, or bowing of the frames. Any such distortion could interfere with the function of the windows or the opening and closing of the doors. Most of the boxes have vertical key pieces, or wooden strips, fastened to their sides to help lock the boxes to the mortar in the cordwood walls.

Cedar Log Ends

Early in the process, we made the decision to use 16" cedar log ends

for the cordwood infill. This length would provide an insulation value of R-24. The cedar logs had been cut in 8' lengths and dried for four years. After that, they were cut into 16" lengths and about 70 percent were split to ensure faster drying.

On the way to being stacked, the logs were dipped in a borate solution (four cups of borax to one gallon of water). Then, they were stacked in single rows for drying. While stacked, the exterior ends of the logs were brushed with a UV blocker (Lifeline Exterior™, manufactured by Permachink) so that the outdoor faces of the log ends would maintain their color. The interior log-end faces were left in their natural state.

Our crew purchased a mortar mixer, and three different individuals were trained in mixing proper cordwood mud. It was very helpful to have an alternate mixer when someone had a scheduling conflict.

The mortar mixture used was the *Flataus' Favorite Mix* of:

- 1 part portland cement
- 1 part hydrated lime type S
- 2 parts soaked softwood sawdust
- 3 parts washed, coarse sand

The overall feel of the mortar is an adobe-style texture that is easily tuck-pointed with a spoon.

The risk of cold temperatures called for the use of protective tarps to guard against freezing and flaking.

Injected Foam Insulation

For insulation, the initial strategy was to use regular coarse softwood sawdust mixed with hydrated lime in the center cavities, but a dearth of coarse softwood sawdust in the area led to an alternate decision. We went to a two-part injected closed-cell foam. The main advantages of injected foam are its high R-value (R-7 per inch) and its ability to bond well with wood. As a bonus, it also tends to fill every nook and cranny.

Cordwood builder Sandy Clidaras of Quebec has been a pioneer in using closed-cell foam in single-wall cordwood builds, so we consulted him for advice. After generously giving of his time and knowledge, he convinced us to order the needed eight kits of foam insulation.

Applying the foam is markedly different from pouring dry insulation into the center cavities. When using injected closed-cell foam, the cordwood wall is first built in 2'-high sections. Half-inch PEX tubes are inserted in the center cavities as the wall is being built. The mortar is then left to harden for at least 24 hours; any less and the wall may be lifted by the pressure of the expanding foam.

Project coordinator Bill Paulson developed an effective method to ensure that foam insulation penetrated every crevice.

The foam is then injected into the tubes. Closed-cell foam comes in two canisters, which must be warmed before being used and then shaken while injecting (this makes certain all the foam is used). There are many companies that make expanding foam, and quite a number of building supply stores also carry the kits. On a 1,200-square-foot home, with 8'-high cordwood walls, the foam will add approximately $4,000 to the cost of construction.

The closed-cell foam is rated at an R-value of 7.0 per inch. So, a 5" cavity gives an R-value of 35. Coupled with the usual 16" cordwood walls' R-value of R-24, we calculated that our walls' insulation value approached R-30.

Our "main-man foamer" Bill Paulson devised an ingenious method of making sure the foam got into every crack and crevice. If he deemed that a cavity was not completely filled he would drill a hole in the longitudinal middle of a log end, place a PEX tubing hose into the log until it reached the bottom, and then inject foam into the unfilled cavity. Bill developed a method of slowly pulling out the tube as he injected the foam, with one hand on the nozzle trigger and one hand on the tube. He became quite accomplished at stopping the flow of the foam before it erupted over the top. After completion of the home, an infrared scan showed no cold spots in the cordwood walls.

The home's interior is open, warm, and inviting. Feather and bear claw motifs flank the entry.

Cold-Weather Mortaring

When we left to conduct another workshop in North Carolina, the cordwood mortaring crew was about one-third finished. Little did we know at the time that the fall of 2009 in northwestern Minnesota would turn into one of the coldest on record. Finishing the cordwood infill in October meant tarping the house, covering the cordwood walls with blankets, and firing up a propane heater. Starting work a little later in the morning allowed the temperatures to rise a bit. The cordwood masonry was finished by late October, and the inside work commenced. The entire cordwood infill was accomplished in less than six weeks.

If at all possible, cold-weather mortaring is something to be avoided. Should the water in the mortar mix freeze, it can cause the mortar to flake and crumble. Since this home was built within a post-and-beam framework, there was no worry about structural integrity, but to have to remortar a complete wall or part of a wall would become a very labor-intensive operation, especially since the mortar flaking may not be immediately apparent.

If you must mortar in cold weather, it is imperative to finish all mortaring before freezing temperatures set in. If this can't be done, then precautions need to be taken to ensure the mortar will not freeze:

- The freshly mortared cordwood wall must be covered with blankets or tarps and secured so it is protected from freezing cold and wind.
- If there is a crew working on different sections (as was the case on this project), the entire building should be wrapped with tarps to cover the work.
- Even though there is a bit of heat generated from the chemical reaction of the portland cement and water, it is not enough to prevent the mortar from freezing when temperatures plummet.
- On this project, not only did we tarp the entire house, but we placed a propane heater in the middle of the house to keep the mortar from freezing.
- It is very important to keep the walls covered for at least seven days, except when actually mortaring.
- According to masonry experts, masonry mortar takes seven days to dry and fourteen days to cure.

There are ingredients that can be added to the mortar mix to retard freezing (such as calcium chloride), but with the soaked sawdust in this mix, no one can be certain that these nonfreeze agents will work properly. So it is best to cover, seal, and provide a source of heat if the temperature is going into the 20s. Reducing the amount of sawdust in the mix as temperatures drop can be helpful, as the retarding feature of the sawdust becomes less important.

The bear claw alongside the door is one of the home's focal points.

Adding Special Effects

Bill and Robert were instrumental in making some of the artistic Ojibwa motifs in the White Earth home. The owner of the home was a member of the Bear Clan, so Bill decided he would put a bear paw in the cordwood wall. It became one of the focal points of the house. The Ojibwa medicine wheel is prominently displayed on the front wall, and a bird feather blends attractively into the entrance wall.

We visited the home a year after completion to do any needed weatherizing. That involved applying Permachink™ around a few log ends that had loosened and stuffing a few checked log ends with white fiberglass. Veronica, the owner, continues to do the necessary homeowner maintenance to keep the home an attractive example of natural building.

This home has caused quite a stir in the surrounding area, and there are plans for building a commercial law office, a ceremonial lodge, and more cordwood homes. We are proud of our involvement and thankful to the tribal members who welcomed us, worked with us, and brought the home to completion. It is a fine example of what happens when desire, cooperation, and good energy come together.

For more information contact www.cordwoodconstruction.org