

CORDWOOD

History:

The origin of cordwood masonry, also called stovewood, stackwall, and stackwood, is unclear: there is some evidence that suggests cordwood masonry came from either Germany or Scandinavia with those who settled on the frontier, though cordwood could have developed in Europe after immigrants returned from America. Cordwood could also have developed within Canadian lumber camps, though the *Encyclopedie de la maison Québécoise* refers to cordwood construction as “of American Influence.”

There is also evidence that cordwood construction may have also originated in the Upper Midwest, utilized by early pioneer builders who were simply responding to conditions on the frontier. Many cordwood structures were built in logged over areas where large, straight timber, needed for traditional log buildings, was unavailable. Most pre-World War II structures are located in Wisconsin, though several are located in Iowa, Minnesota, Michigan, Illinois, and as far west as Montana.

Although the origins of this construction method are unclear, it is certain that residents of the Upper Midwest, particularly those of the late 1800's thru the 1940's, utilized cordwood because it was easy and inexpensive to build earning the name “Depression Housing.”¹

Wood:

It is important to choose woods that shrink and expand very little. It is most common for wood species to shrink, though this can be corrected with proper maintenance. Wood expansion, on the other hand, can have structurally devastating results. Wood expansion can cause wall deformations, movement of corners posts, and uplifting on plate beams. Because of shrinkage and expansion, it is best to choose wood species that are “light and airy” woods or soft woods such as white cedar, larch (tamarack), white pine, spruce, cottonwood, lodgepole pine, red pine, red cedar, and quaking aspen.²

Dense, fine grained hardwoods, such as oak, maple, birch, beech, elm, and southern pines should never be used, especially if they have been dried too long.

Softwoods should be dried for a year or more to prevent shrinkage after construction. If it is necessary to use a hardwood, split the wood and dry it for approximately six weeks to decrease the potential for expansion.

All wood should be debarked. Leaving bark on the wood allows spaces to trap moisture and insects. It is easiest to debark wood in the spring, especially if the wood is harvested in the early spring when the sap is rising. It is most difficult in the autumn as the sap acts like glue.³

Walls can be constructed of all round wood ends, all split wood ends, or a combination of the two. Splitting the wood is common because it decreases the drying time and can reduce cracks from wood shrinkage.⁴

1 Rob Roy, “Cordwood Building: The State of the Art,” (Gabriola Island, BC, Canada, New Society Publishers, 2003), 3-10.

2 Roy, 21-22.

3 Roy, 23-24.

4 Roy, 27.

Mortar:

There are three main types of mortar that can be use with cordwood construction. The most commonly used is a Portland cement mix or a masonry cement mix utilizing sand, water soaked sawdust as a cement retarder, lime, and Portland cement or masonry cement. The color of the sand determines the color of the mortar and the lime makes the mix plastic and easy to use, hardening over time. Water is added to the mixture until it has a plastic texture.⁵

The second type of mortar is Cob mortar. Cob is considered to be more environmentally friendly because the production of Portland cement requires huge amounts of energy. It also is a highly processed material which will never return to its natural or pre-cured state. Cob on the other hand can easily be returned to the ground after the building has reached the end of its useful life. Cordwood construction utilizing cob is often called cobwood.

A third option is referred to as papercrete or paper-enhanced mortar (PEM). By utilizing slurried newspaper into the mixture, the necessary amount of cement and sand can be reduced. Newspaper is also a waste product that is often available in large amounts free of cost. PEM, because it often has 40% paper content, will increase the R value of the wall and make the material more flexible reducing mortar cracks. Unfortunately, PEM has a lower strength so it should be limited to cordwood infill walls.⁶

Construction:

Cordwood masonry can either be used as infill in timber frame, post and beam, or balloon frame construction, or it can be load-bearing.

Foundation:

A cordwood wall needs a well-constructed foundation. A common foundation is a rubble trench, extended below the frost line, topped with a cast-in-place concrete beam. In areas with excessive ground water a drain line should be installed to divert the water away from the walls. The grade beam should be high enough to ensure the wall is well above the finished grade, 4 inches for dry climates and as much as a 12 inches for wet climates. A typical reinforced concrete footing and stem wall can also be used. However, this will involve a significant amount of concrete as the stem wall must be the thickness of the cordwood wall, sometimes as thick as 2 feet. The cordwood wall sits directly on top of the stem wall or grade beam which has been well cleaned and dampened slightly. The first layer of mortar is laid directly on the foundation.

Wall Types:

The most common wall type utilizes a cavity between two mortar beds, an exterior and interior bed, which is filled with insulation. The wood runs the full width, perpendicular to the mortar beds, of the wall thickness. Generally a wall's footprint will be one-third mortar bed, one-third insulation, and one-third mortar bed from interior to exterior.

The insulation can be fiberglass, although this has a high embodied energy and can be unhealthy to work with, shredded beadboard, vermiculite, perlite, or a sawdust-lime powder mixture.

5 Roy, 28-30.

6 Roy, 109-111.

A double wall technique, developed by Cliff Shockey of Skaskatchewan, Canada, utilizes separate interior and exterior 8 inch cordwood walls with 8 inches of batt insulation between. This technique requires the use of 2" x 8" sill plates to support the interior and exterior walls and allow for the attachment of a vapor barrier on the inside of the exterior wall and sheathing on the inside of the interior wall.

Both wall types should be pointed to increase the friction bond between the wood and the mortar, make the surface more water repellent, and to make the surface esthetically appealing.⁷

The Corner:

When constructing corners using cordwood construction, there are two options: post and beam construction with the cordwood as infill panels or built up corners. Built up corners are completed by using individual wood corner blocks, also called quoins, laid perpendicular to each other at each course of cordwood. This method, however, does not allow the insulated cavity to continue around the corner. A modern strategy for built up corners, called the Lomax Corner, is a framed unit of 4" x 4" wood allowing a hollow space for insulation.⁸

Openings, Bond Beam, and the Roof:

Door and window openings can be formed into the cordwood walls using wood window boxes and frames.

A wood beam is built above the cordwood walls to tie the walls together and provide a connection for the next floor or the roof. The roof, like the foundation, is necessary in protecting the cordwood walls from the sun and rain that cause weathering and erosion.

7 Roy, 33.

8 Roy, 43-47.

Technical Information:

Compressive Strength:

Tests completed in the 1970's indicated that cordwood masonry could carry between 30,000 and 40,000 plf, 20 times the design load for a single story building in regions with maximum snow loads.⁹

Later cordwood mortar tests were completed in the mid 1990's as the wood members themselves have little difficulty meeting compressive strength requirements by code enforcement. The mortar, unlike the wood, was considered questionable. Three different mixes were tested at 7 and 30 days curing:¹⁰

Compressive Strengths of Mortar Mixes at 7 Days:

Sand/Sawdust/Hydrated Lime/Portland Cement (9:3:3:2 Ratio) = 778 psi

Same as above but with wood insert* = 584 psi

Sand/Sawdust/Hydrated Lime/Portland Cement (8:4:3:2 Ratio) = 248 psi

Compressive Strengths of Mortar Mixes at 30 Days:

Sand/Sawdust/Hydrated Lime/Portland Cement (9:3:3:2 Ratio) = 1238 psi

Same as above but with wood insert* = 866 psi

Sand/Sawdust/Hydrated Lime/Portland Cement (8:4:3:2 Ratio) = 816 psi

* The wood insert simulates wood plates used to distribute concentrated loads from rafters onto the cordwood masonry.

Overall, the mortar gains compressive strength as it cures. Furthermore, increasing the ratio of sawdust, though it decreases the instance of shrinkage cracks, decreases the compressive force of the mortar and therefore the cordwood wall.

Insulation and R-Values:

Cordwood walls have an average of **R-1.22 per inch of wall thickness**¹¹ though this number varies depending on wall thickness, mortar mix, and insulation type. For an **16 inch wall that is R-19.5** and for a **24 inch wall that is R-29.3**.

By using the double wall technique of 8" cordwood, 8" batt insulation, and 8" cordwood, the R-value is said to be **as high as R-40**.¹²

Fire:

Cordwood walls are said to have a **two to six hour fire rating** because of its mass and high mortar content.¹³

9 Roy, 194.

10 Roy, 213-215.

11 Roy, 218-219.

12 Day Creek, "Cordwood Masonry," http://www.daycreek.com/dc/html/DC_cordwood_masonry.htm.

13 Roy, 197.

Resources:

Books:

Stoneview: How to Build an Eco-Friendly Little Guesthouse

by Rob Roy

http://www.amazon.com/dp/0865715971/ref=nosim?tag=hartworkscom-20&link_code=as3&creativeASIN=0865715971&creative=373489&camp=211189

Cordwood Building: The State of the Art

by Rob Roy

http://www.amazon.com/dp/0865714754/ref=nosim?tag=hartworkscom-20&link_code=as3&creativeASIN=0865714754&creative=373489&camp=211189

Complete Book Of Cordwood Masonry Housebuilding: The Earthwood Method

by Rob Roy

http://www.amazon.com/dp/0806985909/ref=nosim?tag=hartworkscom-20&link_code=as3&creativeASIN=0806985909&creative=373489&camp=211189

Bill Nye's Cordwood (1887)

by Bill Nye

http://www.amazon.com/dp/0548972710/ref=nosim?tag=hartworkscom-20&link_code=as3&creativeASIN=0548972710&creative=373489&camp=211189

The Sauna

by Robert L. Roy

http://www.amazon.com/Sauna-Robert-L-Roy/dp/0930031873/ref=sr_1_2?ie=UTF8&s=books&qid=1245356963&sr=1-2

Building Green: A Complete How-To Guide to Alternative Building Methods

by Clarke Snell and Tim Callahan

http://www.amazon.com/dp/1579905323/ref=nosim?tag=hartworkscom-20&link_code=as3&creativeASIN=1579905323&creative=373489&camp=211189

Videos:

The Complete Cordwood DVD

http://www.amazon.com/dp/097892570X/ref=nosim?tag=hartworkscom-20&link_code=as3&creativeASIN=097892570X&creative=373489&camp=211189

Websites:

Daycreek.com

http://www.daycreek.com/dc/html/DC_cordwood_masonry.htm

Earthwood Building School

<http://www.cordwoodmasonry.com/>

References:

Roy, Rob. "Cordwood Building: The State of the Art." Gabriola Island, BC, Canada: New Society Publishers, 2003.

Day Creek. "Cordwood Masonry." http://www.daycreek.com/dc/html/DC_cordwood_masonry.htm.