# Tofte Cabin

Green Building: Case Study

When Medora Woods decided to remodel a cabin in Tofte, Minn., she wanted to push the limits of sustainable design. In 1997, when the cabin was designed, guidelines and templates were not readily available and no local lumberyards sold the needed materials. Along with her architect, Sarah Nettleton Architects Ltd., she began an innovative, collaborative process to turn her idea into a reality.

The goal was to reduce the ecological cost of the building. To accomplish this goal, Medora and Sarah decided on seven priorities:

- **Design the building to have a "sense of place" by connecting it to its site.** In the feel of the cabin, the Northwoods is invited in via sounds, light and materials.

- **Arrive at "zero" use of energy from non-renewable sources.** The cabin's electrical energy needs will be met using photovoltaics and a wind generator. Heat will come from a water-to-water heat pump. Innovative window design provides natural light during the day and further connects the cabin to its surroundings.

- **Small is good: Reduce list of needs, reuse the existing building.** The footprint of the existing cabin on the site was reused, as was much of the framing lumber. Much of the original cabin and its contents was deconstructed and reused by local contractors.

- **Protect and enhance the site and ecosystem.** Contractors preserved as much of the site as possible by stacking materials in areas that were already disturbed, such as the driveway and garage area. The landscaping restores the native ecosystem, using no exotic vegetation.

- **Select low-impact, resource-efficient materials.** A life-cycle model helped quantify the environmental costs and impacts of each product, from production through disposal. Priority was given to products made from renewable sources and materials that were recycled, low in toxicity, reused and locally produced. For example, wood for construction came primarily from reused or sustainably harvested sources. Stains and sealants had low or no volatile organic compounds (VOCs).

- **Use materials efficiently in design and installation.** Scrap lumber from decking was used in casework. Rigid insulation was pre-cut at the factory to reduce waste at the job site.

- **Send no waste to the landfill.** Unusable construction and demolition material was recycled.

## New strategies

Innovative strategies helped test the limits of how sustainable this cabin could be. Many techniques required creativity, but little additional cost:

- Daylighting
- Super-insulation
- Using materials that come from local sources (no shipping costs) and generate minimal pollution during manufacturing
- Efficiently managing the materials at the site and careful detailing by architects.
- Recycling of construction wastes
- Low-VOC paints

Other strategies had a higher front-end capital cost, but a greater environmental payback.

- Photovoltaics
- A wind generator
- Certified framing lumber
- Geothermal heat
- Using durable materials such as the copper roof.

The time needed for extensive product research by the architects was an expensive part of this project.

## Lessons learned

This cabin was intended as a case study to help make "green building" real in Minnesota.

- Working with "green materials" and techniques was challenging. Local suppliers and contractors were unfamiliar with the materials. This project utilized green materials and employed strategies to reduce environmental impact.

- The cabin's architectural and mechanical designs were arrived at collaboratively instead of the usual "architecture first, mechanical system second" approach.

- A wealth of information is available on products, but there is often no simple way to prioritize. A *recycled* product may not be *low-VOC*; *sustainably harvested* lumber may not be from a *local* source. Life cycle analysis is very complicated due to information gaps.

- Communication is key. Frequent team meetings were crucial, as all participants made substantial contributions. The challenge of how to implement the "grand idea" in a practical way is ongoing for this project.

- Product delivery problems may cause significant delays. Materials with "green specifications" may be more difficult to get in a timely manner, causing bottlenecks in construction.

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# Details

## Project Goal

To build a Minnesota example of sustainable design, taking the concept as far as possible.

## Materials Selection

- Preference given to products made from renewable sources and materials which were recycled, low in toxicity, reused and locally produced
- Douglas Fir roof rafters reused from a local deconstruction project, the Sugar Loaf Building
- Certified sustainable framing lumber from the Menominee Forest
- Recycled wood from Duluth Timber Company
- Reclaimed lumber from Lake Superior, Timeless Timber Co.
- Garage door made with wood recycled from old pickle vats
- Siding and framing lumber from existing cabin were reused
- Lumber locally harvested and milled when other options not available
- Certified sustainable plywood from Collins Pine in Oregon
- Materials efficiency a priority. For example, scrap lumber from decking used in casework
- Low-VOC exterior stains and sealants

## Site

- Priority to protect and enhance the site and ecosystem
- Reused the footprint of the original cabin
- Buildings designed around the "sense of place"
- Ecological survey of land conducted to help decide what to protect
- Landscaping restores native ecosystem, using no exotic vegetation

## Energy

- Goal of eliminating use of fossil fuels is nearly reached. Appropriate mechanical systems for heating were integrated into the cabin's architecture.
- Renewable energy system: Photovoltaics and wind generator by Solar Design Associates
- The cabin uses the electric grid as its battery, with the goal of balancing its actual energy use with the energy it generates from wind and sun.
- Radiant floor heat, low-temp supply from a geothermal heat pump
- Thermal storage tanks provide mass storage for supply temperature lag
- Super-insulated building envelope and R 8.4 windows
- Fresh air exchanger

## Daylighting

- Roof form specially designed for daylighting
- To optimize daylighting, a model of the cabin was tested in the Daylighting Laboratory at the University of Minnesota's School of Architecture

## Indoor Air Quality

- Materials picked to promote indoor air quality and eliminate need for worker to wear masks
- No CFCs or formaldehyde
- AMF sealants and paints used to avoid VOCs

## Waste

- Goal to send no waste to the landfill
- C&D wastes recycled at Voyageur Disposal and Processing, Inc. (Canyon, Minn.) Masonry waste used as road fill. Wood waste was chipped, reused or burned. Recycled materials: glass, copper wire and plumbing, and asphalt shingles.
- Extruded rigid insulation cut to job size at factory to avoid job site waste.

## Other

- Priority to connect to place and give back to the community
- Appliances in the original cabin were donated to a family that lost their house in a fire
- Due, in part, to this project, Canton Lumber in Minneapolis now stocks certified sustainable lumber

## Environmental and Economic Benefits

- Energy needs met on-site. Projections show zero net energy consumption
- Minimal material landfilled.

## Project Data

**Contact**: Sarah Nettleton AIA
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**Project Name:** Tofte Cabin

**Facility Type:** Remodeled residential cabin

**Location:** Tofte, Minnesota

**Design Team:** Sarah Nettleton Architects Ltd., Sarah Nettleton AIA, Christine Albertsson AIA, Don Rowe AIA, Dimple Sheth

**Consultants:**

- **Architectural Technologies** –James Larson, Architect
- **Mechanical –** Gausman & Moore, Jim Keller, PE,
- **Structural** –Mattson/Mcdonald Inc., Stephanie Cross PE
- **Lighting** – Schuler & Shook, Inc., Michael DiBlasi
- **Daylighting –** Mary Guzowski, School of Architecture, University of Minnesota
- **Energy and Renewable Energy Systems** – Solar Design Associates, Robert Erb
- **Ecologist** – Chel Anderson
- **Feng Shui** – Carole Markus Hyder B.B.E.
- **Interior Design** – Doran Thayer

**General Contractor:** Tofte Construction, Greg Tofte