Cabin pioneers sustainable building approach

"Our goal is to build a home that is healthy to live in using materials and systems with a dramatically reduced impact on the environment." – Owner

TEAM MEMBERS

Design Architect: Nathan Good, AIA, IIDA

Intern: Maggie Bjorgum, Studio 3 Architecture, Inc.

Builder: Rich Elstrom, Rich Elstrom Construction

Project Manager: Mark Ward, Rich Elstrom Construction

Interior Designer: Georgia Erdenberger, Czopek & Erdenberger

Landscape Designer: George Erdenberger

Structural Engineer: Andy Stricker, Stricker Engineering

Mechanical Engineer: Gene Johnson, Solarc, Inc.

Energy Consulting: Charlie Stephens, Oregon Dept. of Energy

Solar Consultant: Doug Boleyn, Cascade Solar Consulting

Green Roof Consultant: Pat Lando, Lando & Associates

By Ann Grim
Oregon Department of Energy

When their long-time family Cannon Beach vacation home was destroyed by fire three years ago, the Portland owners knew they would rebuild. And, they knew their new home would be special.

Many would see the misfortune as a chance to replace an old rambling beach home with a larger, high-tech home to better accommodate family, extended family and guests. But the owners decided this was an opportunity to place their values into action. Their strong respect for the coastal environment was their guide throughout the entire rebuilding process – design, systems, material, construction and use.

"Our first goal was simply to replace the 30-year retreat we'd lost to fire. At least as important to us, however, was the opportunity to inspire others to think about their own projects in new ways. From painting a room to remodeling, or simply replacing home cleaning products, we can all make choices that are more gentle on the earth," said the owner.

The result is an uncommon home – a thoughtfully planned 2,263-square-foot home that is designed to produce more energy than it consumes on an annual basis and to impact the environment as little as possible.

The owners want others to study the lessons learned from their sustainable building project so more homes can be built with a similar result. They contacted Energy Analyst Charlie Stephens with the Oregon Department of Energy before designing their home. The department reviewed the proposal and agreed to provide technical assistance, monitor the home for a minimum of one year and share the results with the building industry.

The house and its systems are being monitored over the next several years by students and staff from the Oregon Renewable Energy Center (OREC) at the Oregon Institute of

Technology (OIT) in Klamath Falls. There are 90 sensors in the house and systems, including thermal mass temperature sensors in two of the exterior walls. Over time, OIT students and Oregon Department of Energy staff will study the behavior and performance of the home. The Department of Energy will produce a case study documenting the results at the end of the first year.

"This is a great opportunity to see how leading-edge technology and sustainable building materials work in practice," said Stephens. "We appreciate the owner's support along with the architect, builder, on-site project manager, solar contractor and all the sub-contractors working on the home. This project would not have been possible without a team effort from the owner on down."

Design process

Early in the pre-design stage of the project, the owners embraced the idea for an integrated design team.

"The collaboration among the design team was one of the most fascinating 'behind the scenes' aspects to the home," said Nathan Good, the project's architect. "The owners, architect, interior designer, and landscape designer worked collaboratively on all aspects of the home's design over the period of several months, with few boundaries between disciplines."

The contractor, Rich Elstrom, joined the design team during the design development stage of the project. Elstrom, who only builds on the Oregon Coast, provided valuable input to a multitude of factors ranging from cost and constructability to the local resourcing of materials and design for durability and low-maintenance. The integrated design team held a number of design charrettes, occasionally joined by content experts in energy, solar design, structural engineering, and sustainable materials.

Home layout

The home is aligned facing South on a hillside to optimize the spectacular ocean view and to allow for maximum natural light to enter the home. High clerestory windows and a 19-foot ceiling in the great room provide excellent daylighting even on overcast days common at the Oregon Coast.

Neighbors that are higher on the hillside don't view another rooftop. They see green – vegetation on an eco-roof. With strawberry vines and tiny plants and evergreens, the eco-roof effectively filters the rainwater that falls on it and successfully blends into the hillside. Solar electric panels are placed on a lower roof over the south porch that conceals them from view.

With two bedrooms and attached bathrooms, the home has a simple layout. A great room/kitchen area separates the two bedroom/bathroom suites. A loft above the kitchen has space for an office and an additional sleeping area with bathroom.

Outdoor "living" space is easy to find. A large covered patio faces South toward picturesque Haystack Rock. The patio roof shades the expanse of the living room windows during the summer. An upper deck area off the loft with view of the ocean to the west provides an outdoor nook that is protected from the wind, but nestled under a mature coastal spruce tree preserved by careful siting of the house and protected during construction.

Six large cedar columns from Collins Pine's FSC (Forest Stewardship Council) certified sustainable forest products "anchor" the corners of the home, patio and car closet. Some of the Douglas fir flooring was salvaged from windfall trees. The artistic open stairwell was crafted from pieces of beech given to the owners from an in-fill project in Portland and spruce branches that were cut from a tree on the property.

Energy use

The home is well insulated. Roof insulation is approximately R-50. The 12-inch walls were constructed with Durisol™ sustainable insulated concrete form blocks, a Swiss technology that has a long history in Europe but is new to the Northwest market. The Durisol blocks are air and water sealed. The R-value above grade is 25.6 and below grade is R-21. Window U-value averages 0.32.

The home is heated with ventilation air delivered by three very high efficiency Stirling energy recovery ventilators (ERVs), warmed by hot water coils for each zone. The hot water is provided by 40 Thermomax evacuated tube thermal collectors (out of a total of 80 in the array on the embankment below the house). During the summer, the heat generated is pumped into the geothermal wells below the array. Later, during the heating season, a 1½-ton geothermal heat pump retrieves energy from the wells and moves it to a storage tank in the basement for use by the hydronic pumping loops.

Domestic hot water is provided by the other 40 Thermomax tubes, and stored in a separate storage tank in the basement. Cooling isn't needed in most of Oregon's coastal climate zone, but the ERVs could provide nighttime cooling as part of their normal function if conditions required it.

An open stairwell was crafted from pieces of beech saved from an in-fill project in Portland and spruce branches from a tree on the property. Photo courtesy of the Oregon Department of Energy.

The owners carefully selected appliances for low annual energy consumption. Attention was paid to minimizing phantom loads (devices such as doorbell transformers that draw power even when "off"). The premium efficient dishwasher, clothes washer, and refrigerator qualified for an energy tax credit through the Department of Energy.

A 5 kW photovoltaic array on the lower (South) roof efficiently produces energy that goes into the utility grid. Because of the lower amount of insolation available in Oregon's coastal areas (especially compared to Eastern Oregon), an oversized array was needed to provide enough energy to balance the home's draw from the grid. The solar array also qualified for an energy tax credit from the Department of Energy.

"The owners have created a unique and beautiful home using principles that we believe can be applied to any home," said Stephens. "When applied successfully, such buildings can have very little impact on the earth's living systems while contributing to Oregon's renewable energy supply."