The University of Alaska Fairbanks Sustainable Village is a living laboratory for students, faculty, and building scientists to experiment and learn about energy efficient building, alternative energy in the north, and sustainable ways of living. The Cold Climate Housing Research Center (CCHRC) worked with UAF to develop extremely low-energy climate-compatible homes for an affordable price.

Design

In Fall 2011, UAF students participated in an interdisciplinary design competition to create a sustainable housing concept for the Sustainable Village. The winning team, Circle Visions, modeled a super-insulated home with a large second-floor deck, a shed-style roof, big solar windows, and thermal shutters. They worked with CCHRC over the winter on design development, and many student ideas were infused into construction plans.

The four 1,400-square-foot homes demonstrate experimental building techniques and energy systems, with a focus on minimizing energy demand and impact on the land. Each home has a unique assortment of wall assembly, foundation, and heating and ventilation system so they can be tested against one another.

Four homes were built in the summer of 2012 by a crew of seasoned carpenters and student hands. The construction process was a training tool for students and a demonstration for the community, as many industry, policy, and school groups toured the site.

Building Systems

Each building envelope is super-insulated to about R-60, with multiple framed wall systems that eliminate thermal bridging through the studs and prevent condensation inside the walls. Three homes use the REMOTE wall developed by CCHRC, with 5.5 inches of batt insulation in the wall cavity and 8 inches of rigid foam outside the sheathing. The southwest home has 5.5 inches of batt insulation on the inside wall and a 12-inch standoff wall filled with dense-pack cellulose insulation.

Each home has a ventilated shed-style roof with 2 feet of blown-in cellulose and a continuous 2-inch air gap underneath the roof deck to keep the roof cold and dry.

There are two styles of foundations at the Village—a pilings foundation, which is standard for building on permafrost, and an innovative raft foundation that rests directly on the ground. The raft consists of floor joists elevated off the ground with EPS foam board spacers, and soy-based polyurethane foam sprayed through the joists against a geo-textile mat. The R-60 foundation
provides a thermal break to slow heat loss into the ground and prevent permafrost thaw.

Energy

The homes are projected to use less than 27 million BTUs per year (the equivalent of 200 gallons of heating oil), 80 percent less than the average Interior home. Heating systems include solar hydronic, biomass, and conventional sources like propane and diesel.

Two homes have solar thermal collectors with radiant in-floor heating, each with a different backup system—one a small oil space heater and the other a propane boiler.

The other two use the BrHEAThe system, an innovative heating and ventilation system developed by CCHRC specifically for super low-energy homes. A small diesel heater (typically used for long-haul truck rigs) injects heat into HRV supply air, and is distributed to each room through a forced air system. This system has strong potential in rural Alaska, where HRVs aren’t popular or are not used at all.

Local materials

The Sustainable Village incorporates many local and recycled materials and showcases Alaska culture. The piling foundations were used in utilidors on military bases; steel siding was cut from reclaimed dredge pipe from turn-of-the-century gold mining operations; and walkways were made of wood chips from site-clearing.

Highlighted

- Modeled to use 80% less fuel than average Interior home
- Estimated Construction cost: $200,000/home
- Completed in less than 5 months
- Heating: Solar, biomass, BrHEAThe system
- Walls/Foundation R-60; Roof R-80
- Self-contained sewage treatment plant and delivered water

Monitoring

CCHRC researchers are working with students to monitor the performance of the homes across several areas: energy use, cost, indoor humidity and ground temperature. The monitoring program will shed light on the most cost-effective building techniques and energy systems, and help inform future housing designs.

Application

The Sustainable Village provides a testbed for arctic building science and energy research right in our backyard. Many of CCHRC’s housing designs are prototyped in remote Alaska communities, where the need for sustainable housing is often greatest. The remoteness, however, makes it difficult to research and troubleshoot issues that are inherent to prototypes.

The Sustainable Village shares many of the same challenges of rural Alaska, such as severe cold, permafrost, and high energy and construction costs. What we learn here will be applied across the state to advance energy efficient, healthy housing for all Alaskans.

Learn all about the Sustainable Village at makinghouseswork.cchrc.org.