COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC

Monitoring Sustainable Northern Shelter in Anaktuvuk Pass, Alaska

Location, Climate and Design Challenges

Anaktuvuk Pass is a Nunamiut community located in a mountain pass in the cold and dry Brooks Range. Many of the current houses in Anaktuvuk Pass are not well suited for the harsh cold conditions of the area.

Tagiugmiullu Nunamiullu Housing Authority (TNHA) and CCHRC set out to build a prototype house that:

- Has lower annual fuel usage than the current houses.
- Maintains healthy indoor air without using an HRV.
- Reduces costs for shipping building materials and construction.
- Reflects the culture and daily activities of rural indigenous occupants.

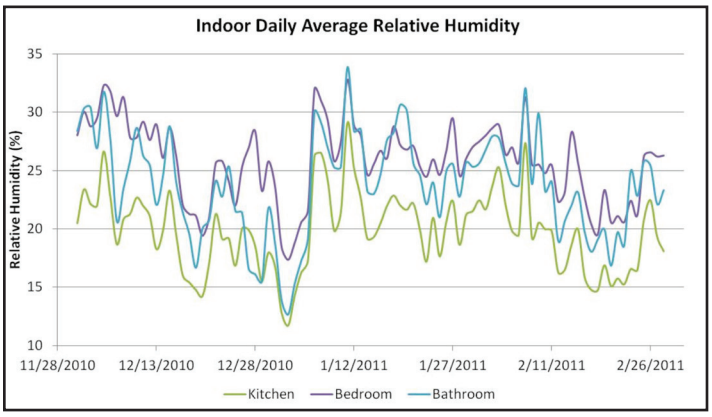
Prototype Approach

The resulting prototype home has an envelope of nine inches of spray polyurethane foam that keeps the house warm and air tight. It is built of metal studs and plywood sheathing to minimize freight costs and increase durability. The house was mostly built by students from Iligsagvik College in the course of six weeks. The heated portion of the house is 800 sq.ft., but there is an additional unheated garage and cold room for subsistance food storage. The house also has an array of solar photo-voltaic panels to supplement the electrical use.

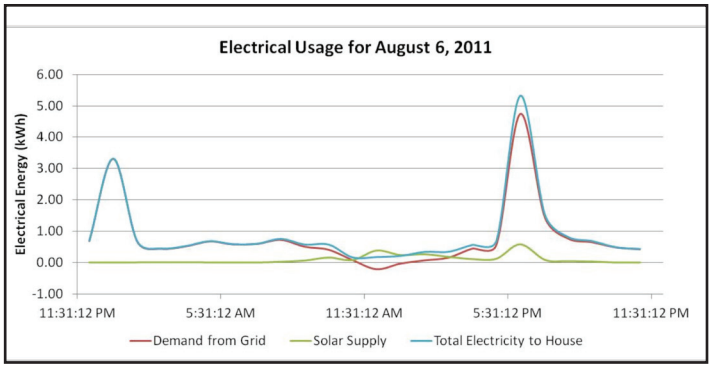
Research Results

CCHRC partnered with the National Renewable Energy Laboratory (NREL) to study the heating demand, electrical use, and indoor air quality of the prototype.

- Monitoring revealed that the Anaktuvuk Pass prototype needed a better ventilation system to maintain healthy indoor air based on the humidity and CO_2 levels. A new system was installed in December 2011; it will be monitored to verify healthy indoor air.
- In years 1 and 2 the house consumed 190 and 240 gallons of heating fuel, respectively; a improvement over the 880 gallons a year that the average rural house uses (AHFC, 2009). The newly installed ventilation system is expected to further lower comsumption.
- The electrical usage in the prototype has been variable and has averaged 1100 kWh/month; this is mostly a function of how the homeowners are using their house.
- The solar array has contributed an average of 7% of the total house electrical demand to the house, offsetting the grid power.



The interior relative humidity during the winter in AKP is below the 30-50% range considered healthy for humans.



Around noon, the solar panels produce more power than the house is using (see red line which represents grid power).

The prototype home in AKP has a highly insulated thermal envelope to minimize fuel demand.

References

AHFC (Alaska Housing Finance Corporation). (2009) Alaska Housing Assessment. Anchorage: Information Insights. Retrieved from http://www.cchrc.org/docs/reports/TR_2009_02_2009_AK_Housing_Assessment_Final.pdf

More information on this project can be found at: http://www.cchrc.org/anaktuvuk-pass-prototype-home

NREL
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Monitoring Sustainable Northern Shelter in Quinhagak, Alaska

Location, Climate and Design Challenges

Quinhagak is a Yup'ik Eskimo village in southwestern Alaska, with a wet and windy climate. The houses in Quinhagak are susceptible to the wind and rain, and many have extensive mold and rot due to wind driven rain and poor drying conditions.

Village of Quinhagak and CCHRC set out to build a prototype house that:

- Has a building envelope that lowers annual fuel usage and that can resist water-infiltration from wind-driven rain.
- Addresses moisture and mold problems associated with rot that commonly cause upper respiratory infections in children and elders.
- Has a structural system that addresses the cultural preference for an open plan, while lessening the expense of shipping large structural members.
- Has a construction assembly that precludes the need for heavy equipment and reduces shipping costs for remote villages.
- Reflects the culture and daily activities of rural indigenous occupants.

Prototye Approach

The resulting 800 sq.ft. prototype home has a monolithic envelope of spray polyurethane foam that keeps the house warm and air tight. It is octagonal in shape so that wind blown snow does not build drifts that block windows and doors. The prototype was built in seven weeks by a six person work crew and without heavy machinery. It has a heat recovery ventilator to ensure healthy indoor air.

Research Results

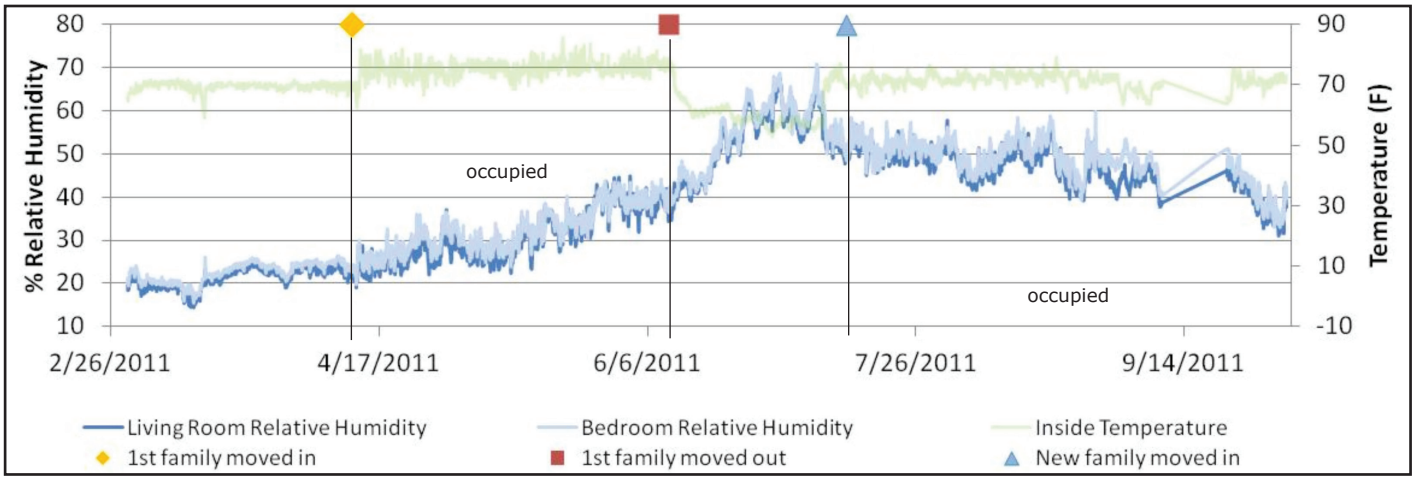
CCHRC partnered with the National Renewable Energy Laboratory (NREL) to study the heating demand, electrical use, and indoor air quality of the prototype.

- Monitoring revealed that the Quinhagak prototype had healthy indoor air based on the humidity and CO_2 levels.
- The house consumed only 171 gallons of heating fuel in the first year, an 80% improvement over the 880 gallons a year that the average rural house uses (AHFC, 2009).
- It used about half as much electricity (an average of 350 kWh/month)as the average Alaska house (661 kWh/month) (U.S. EIA (2009).

References

AHFC (Alaska Housing Finance Corporation). (2009). Alaska Housing Assessment. Anchorage: Information Insights. Retrieved from http://www.cchrc.org/docs/reports/TR_2009_02_2009_AK_Housing_Assessment_Final.pdf

U.S. Energy Information Administration. (2009). Table 5. Residential Average Monthly Bill by Census Division, and State. Retrieved from http://www.eia.doe.gov/cneaf/electricity/esr/table5.html.



Indoor relative humidity levels climbed to a healthy range of 30-50% while the house was occupied. Further monitoring will determine if it remains healthy over the winter.

More information about this project can be found at: http://www.cchrc.org/quinhagak-prototype-home

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