2007 has been a very busy year for the Cold Climate Housing Research Center. The rising cost of energy is crippling many communities in our beautiful state. Even our urban areas are hurting from the escalating gas, heating fuel, and electricity prices. From an individual to a global perspective, sustainability is the challenge we now face. Our focus needs to be on the elements we can most effectively address—one being the shelter that our families and neighbors rely on.

In light of pressing need for more sustainable building practices, it is my pleasure to present to you our 2007 Research Report. With the completion of our research and testing facility in 2006, the focus of our activities has returned to projects that address the challenges of the built environment in the Arctic. This report details our research activities and projects to date, with emphasis on the 2007 fiscal year. It highlights various lessons we have learned from our research, focuses on a few current projects, and includes a compendium of past, current, and future projects.

At CCHRC, we aim to provide transparent research, testing, and demonstrations of a multitude of practical technologies and practices that can be used to make living in the Arctic more sustainable and affordable. Scientific research is necessary for providing accurate data on technologies being developed to address arctic challenges. To further enhance the transparency of building material performance, CCHRC is also working to establish a Product Testing and Development Lab for Cold Climates. This program will create a platform to certify products that meet rigorous Alaska-based standards. Finally, demonstration projects have always been a large part of the work we do here. From our early design of an egress window to our current Hybrid Micro-Energy Project, demonstrations are an important part of showing how new technologies can be applied for use by northern people in real-life situations. These three approaches—research, product certification, and demonstrations—complement each other, providing the basis for our knowledge on building technology and allowing us to share that information with others.

As we move into a new year, we all have a great responsibility to find solutions and direction toward a bright future for our children and grandchildren. I hope all of you take moments to enjoy the life we have here at the top of the world, in this amazing timeless place where wild space and nature surround us. Alaska may very well be where the critical solutions are found to ensure a sustainable future for mankind.

“Alaska may very well be where the critical solutions are found to ensure a sustainable future for mankind.”
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CCHRC Mission:
Promoting & advancing
the development of healthy, durable, & sustainable shelter for Alaskans & other circumpolar people through applied research.
About CCHRC

The Cold Climate Housing Research Center (CCHRC) is an industry based, non-profit corporation created in 1999 to facilitate the development, use, and testing of energy efficient, durable, healthy, and cost effective building technologies for Alaska and the world’s cold climate regions. The research center was conceived and developed by members of the Alaska State Home Builders Association, representing over 1,200 building industry firms and groups, the largest per capita builders’ association in the nation. Ninety percent of CCHRC’s charter members are general contractors from across the state. The Alaska professional building community is highly regarded as a national leader in energy efficient housing design and construction.

CCHRC takes an entrepreneurial approach to fulfilling its mission. By working with private and public entities to develop projects which address Arctic challenges, CCHRC creates and engages in new business opportunities with diverse partners. This process is supported by Regional Advisory Committees that provide CCHRC with input relating to market needs and challenges, and Industry Advisory Committees that provide CCHRC with input and collaboration on product testing and development.

The heart of CCHRC’s operations is the Research and Testing Facility, which opened September 23, 2006. The RTF is a 15,000 sq. ft. building which incorporates a multitude of building technologies, products, and designs. It provides a space in which to develop and perform projects and the over 1000 sensors installed throughout the structure give CCHRC important data relating to building in Arctic conditions.

sustain•ability suh-steyn-uh-bil-i-tee
Meeting real-world needs today without compromising the future.
How is the rapidly escalating cost of energy affecting you? Planning to set your thermostat at 65 degrees Fahrenheit this winter and wear an extra sweater?

Let’s face it, while that’s good advice for someone who lives in Pennsylvania, a lot of Alaskans are already doing that—we have the highest home heating needs and costs in the country. Living and working in the Arctic also imposes other tough challenges. Our severe climates, unstable soils, and the potential for seismic activity require strict building standards.

A majority of the building materials used in the Arctic are brought in from outside. This does not bode well for Alaskan’s pocketbooks, and building materials on the market do not always perform well in the Arctic. Some existing homes were built as if they were sitting in Washington or Oregon. We need to look for serious answers in order to continue living and thriving in this harsh and unique environment.

Ironically, people living here do not always realize that they are living in a northern climate. As an example a woman once told me how she would go from her heated garage in the morning to her covered garage at work and back again, never having to step into the freshly fallen snow in her high heel shoes. For this person, living in and around cold weather was merely a set of circumstances to be avoided. But many of us cannot afford to avoid the environment we live in, nor should we. Adaptation can improve our quality of life, cut our expenses and reduce our impacts on the environment.

According to the U.S. census, Alaska has more than 271,000 housing units (including houses, duplexes, mobile homes, and apartments). The 2005 Housing Needs Assessment estimates that more than 45,000 households in Alaska are potentially eligible for weatherization services. According to the same study, an estimated 22,392 households are considered overcrowded with less than 200 square feet per resident. 4,500 of these units are in need of total replacement, at an estimated cost of $873 million.

The answer to getting better built, more energy-efficient housing in Alaska is complex—it is not just one problem and it’s not just one answer. We need to look at more efficient and alternative heating and electrical systems, better ways of insulating and ventilating our homes, how to build on frozen and saturated soils (and a more alarming trend, how to withstand the shifting of the melting permafrost), how to clean and recycle our gray and black water on site—the list goes on and on.

“Better research and testing for cold climates can improve our quality of life, decrease energy use, and reduce costs.”
Alaska’s building and housing organizations are united in the recognition that more original research is needed. Better research and testing for cold climates can improve our quality of life, decrease energy use, and reduce costs.

In 1999, the Alaska State Homebuilding Association, an industry association, decided that there was not enough science and research on the effectiveness of current building products and practices in cold climates. The homebuilding association knew that more energy-efficient, affordable, and sustainable structures could be built in Alaska. As a result, it established the Cold Climate Housing Research Center to develop and advance healthy, durable, and economically sound shelter for people living and building in the north.

The Cold Climate Housing and Infrastructure Research and Testing Facility in Fairbanks serves as a working lab and model facility for Alaskans. CCHRC can provide us the technical information we need to increase our energy efficiency, reduce our impact on the environment, and improve our quality of life.

As we Alaskans continue to pay the highest energy costs in the nation it is worth considering the importance of improving our understanding of how to adapt and live in this unique environment in which we make our homes.

Summer at CCHRC:
The green roof of the CCHRC Research and Testing Facility planted with native Alaskan wild flower seeds.

Winter at CCHRC:
Photo of the solar photovoltaic arrays at the Research and Testing Facility, part of the Hybrid Micro-Energy Project.
CCHRC Goals:

*Identify issues critical to creating adequate shelter and related infrastructure for circumpolar people.*

*Develop research projects to address these issues and initiate solutions.*

*Establish a product testing and certification program to help expand local business enterprises.*

*Assure long term viability of the organization through a diversified funding base.*

*Expand partnerships within the circumpolar north to include diverse elements of the building community.*
The CCHRC Research Agenda

CCHRC uses applied research to find practical solutions to the real world problem of building shelter that is healthy, durable, and sustainable.

Today the issues around sustainability have taken on a new urgency with fuel prices skyrocketing, the polar ice caps and permafrost melting, and other resources such as water and gravel becoming critically short in supply. In this context the important housing research goals for CCHRC are to find cost-effective and affordable ways to (1) reduce the environmental and health impacts of buildings; (2) develop more sustainable communities; and (3) assist builders, homeowners and others in responding to these challenges.

Listed below are some research topics which respond to the above goals. For each of these topics we need to find the best solutions for the circumpolar north, test the ideas or products in our climate and circumstances, demonstrate their effectiveness, and, where possible, develop new products or technologies that are manufactured locally.

We must develop:

- Cost-effective, energy efficient, and attractive building envelope designs, including wall systems, roof and floor systems, doors, and windows;
- Cost-effective, energy efficient, and comfortable ventilation solutions, including heat recovery and air filtration systems;
- Renewable energy systems for houses, buildings, neighborhoods, villages, and cities;
- Energy efficient and healthy lighting and water systems;
- Cost-effective and durable foundation systems for a changing northern environment;
- Cost-effective energy retrofit programs for existing homes and buildings;
- Tools and training materials for the integrated design of green buildings and communities; and
- Standards and codes for buildings and buildings systems, products, and materials.
Mobile Test Lab/REMOTE Wall

Under the Building America program we also built a Mobile Test Lab (MTL), a moveable trailer designed to test various construction techniques in different climates. CCHRC built the lab and transported it to Juneau where it is used by Marquam George and students at the University of Alaska South East to test a variety of wall sections. To date, the lab has provided invaluable data on wall performance in South East Alaska’s cold and wet climate.

Among the wall sections tested is one developed at CCHRC and dubbed “REMOTE.” REMOTE, which stands for Residential Exterior Membrane Outside-insulation TEchnique, has proven to be a superior wall design for resisting moisture and mold build-up. REMOTE is a modification of the Canadian PERSIST system and is a specific version of a class of wall systems that are characterized by having most of the insulation and the air/vapor barrier outside of the exterior wall and is generally referred to as the outside insulation technique (OIT). There are several advantages to having the insulation and the air/vapor barrier outside of the exterior wall:

a) The sheathing (plywood) and wall framing (top plates, sills, and studs) are inside of the air/vapor barrier and can dry to the inside of the house thereby eliminating the formation of mold and rot in the walls.

b) The air/vapor barrier is tighter—thus saving energy—since the number of penetrations for wiring is much reduced and the complications of intersections with interior walls and floor joists are eliminated.

c) Installation of the vapor barrier is simpler because the requirement to carefully detail a large number of wiring penetrations is eliminated.

CCHRC has tested the REMOTE wall both in houses built in Fairbanks and in wall sections in the MTL. In each test the REMOTE wall has demonstrated tight shell qualities and showed no signs of condensation within the wall. In the MTL, the REMOTE wall assemblies outperformed (dried faster than) all of the other wall types tested. In a second round of tests in the MTL we tried a variety of different outside insulation techniques and a variety of extra insulations in the cavity. All of the walls performed reasonably well, except for ones with additional foam in the wall cavity (those did not dry well after being subjected to intentional leaks). The classic OIT wall sections performed very well and much better than standard wall types. For more information on the REMOTE wall system please read the following CCHRC reports: Research + Projects > Reports > RR 2005-04, RS 2007-03, RR 2006-01 & RS 2007-02.
Healthy Homes in Alaska

In the Healthy Homes in Alaska project CCHRC looked at the effects of poor indoor air quality (IAQ) on the health of children with asthma and remediation techniques. Generally speaking, homes in which asthmatic children live have poor air quality compared to control homes where no asthmatic children live. The purpose of this project was to demonstrate cost effective, preventive measures to correct health hazards in the home environment that produce serious upper respiratory illness in children. The Healthy Homes project added additional services to the weatherization protocol addressing the sources of moisture in the home and the removal and replacement of water-damaged materials and furnishings. It also assessed the effect of resultant changes in indoor air quality on the health of the residents.

The Healthy Homes in Alaska project was a complex, difficult, and important study. It asked the two-part question: “Can we improve indoor air quality by augmenting the standard weatherization protocol and can that improved IAQ lead to better health for children with asthma who live in the homes that are remediated?” We can give a qualified “Yes” as the answer to both parts of the question. The augmented protocol in the client houses and the standard protocol in the control houses resulted in homes with similar post-remediation IAQ. That is, the augmented protocol appears to have improved houses with much worse IAQ to an IAQ comparable to that reached in the control houses using the standard weatherization protocol. And, with caveats relating to the small sample sizes in this study, this improved IAQ appears to have improved the health of the children. CCHRC conducted the Healthy Homes in Alaska study under a contract from HUD and in collaboration with the Alaska Housing Finance Corporation, weatherization agencies, University of Alaska, and Tanana Valley Clinic. For more information please visit our website: Research + Projects > Reports > RR 2005-03

Interior Air Quality (IAQ), Ventilation, and Filtration Studies

CCHRC has funded and collaborated on a number of studies related to ventilation in residential housing. Together these studies provide the following lessons: The old adage “Build it tight and ventilate it right” is born out in a variety of studies. The house needs to be airtight to prevent heated air from leaking outside and to prevent polluted air from entering (e.g., from an attached garage or from radon bearing soil beneath the house). A tight house must be ventilated to remove odors, moisture, and to provide adequate fresh air for the occupants. This ventilation should meet the ASHRAE 62.2 standard and requires some kind of mechanical system. In the colder regions of the state, the best ventilation system is a whole-house heat-recovery ventilation system that provides tempered fresh air to most rooms and evacuates stale air from kitchens, baths, and utility rooms. We are beginning to recognize the importance of filtering the incoming and indoor air. This has obvious benefits during forest fires events, but also can provide important health benefits for those with allergies and asthma. Reports from these studies are available on our website: Research + Projects > RR 2002-03 & RR 2005-01
Foundation Studies

CCHRC currently has a number of ongoing foundation studies. While these studies are not complete, there are some interim conclusions that are worth discussing. Paul Perreault, who is a practicing engineer and is seeking an advanced degree at the University of Alaska Fairbanks, is conducting a study of frost-protected shallow foundations (FPSF) in Fairbanks. Frost-protected shallow foundations are foundations that are installed above the seasonal frost depth and protected against freeze-thaw cycling by insulation applied outside of the foundation. They are less expensive to install since they require less materials and excavation. They were developed in Scandinavia and have been used in other parts of the US. There are provisions in the code books for FPSF in regions that have 4000 air-freezing-days or less; however, interior Alaska has about twice that many air-freezing-days, so there is no guidance in the code books for this region. Nevertheless, FPSF foundations have been used in and around Fairbanks for decades and appear to be successful. This work is directed at understanding the use of FPSF in arctic regions and developing standards that can be incorporated in the code books so they can be more widely used with confidence. Based on the preliminary work reported so far on our website, it appears that standard designs work reasonably well, but there may be some modifications required depending upon the soil type. We hope to have some final recommendations available by summer of 2008.

Cold Weather Concrete

Pouring concrete in Alaska has always been subject to seasonal difficulties. Standard concrete mixtures do not cure properly in temperatures much below 32 degrees Fahrenheit because the water freezes, significantly weakening the concrete. To demonstrate a new cold weather concrete mixture and the most reliable method of pouring it, a team, including the Cold Regions Research and Engineering Lab (CRREL), the Juneau Economic Development Council/SpringBoard, CCHRC, University Redi-mix and University of Alaska engineering faculty, did two test pours during March of 2007 at the CCHRC Research and Testing Facility. The slabs were prepared on frozen ground in unheated areas where the temperature ranged from approximately 32 degrees to -10 degrees throughout the placement and curing process. Each pour had a separate set up and the slabs’ curing time was monitored throughout the process. The compressive strength was tested at regular intervals after being placed. The tested formula performs well in cold weather overall. The team was able to lay two different
slabs at ambient temperatures well below freezing. Use of this process will allow Alaskan contractors to extend the construction season without building enclosures and will result in cost savings of up to one-third, according to Dr. Charles Korhonen, retired CRREL scientist. The details of the formula and the installation techniques are available on our website: Research + Projects > Reports > Snapshots > RS 2007-09

Residential Forced Air Furnace Studies:

*Over-sizing of furnaces in Anchorage area homes*

The purpose of this study was to develop a method for monitoring forced-air furnaces during winter conditions and to determine how well they are sized for the home’s design heat load (heat required at the design temperature, which is -18 degrees F in Anchorage). A “rule of thumb,” common for the design heat load in Anchorage area homes, is 40 BTU’s heat loss per square foot of floor area. This study found that forced-air furnaces in this area are oversized on average 121% (more than two times too big). This study found that AkWarm energy rating software used to rate nearly all new homes in Alaska on average over estimated design load by 8% and in no case underestimated the design heat load by more than 11%. Which is very accurate for this type of calculation. The final report is available on our website at Research + Projects > Reports > Research Reports > RR 2002-02.

Design Heat-load Calculator

Following the above study, an add-on software program was written to use AkWarm to calculate the design heat loss for a home. The program produces a report that can be used to properly size a heating system for the home. It requires you to have an AkWarm Home Energy Rating computer file for the home of interest. The AkWarm file contains information about the insulating levels, air tightness, and other important thermal characteristics of the home so that the recommended size of the boiler is appropriate for the individual home rather than an average calculation using a “rule of thumb.” A link to this calculator is available on our website at Research + Projects > Reports > Best Practice Reports > BPR 2003-01.

Combustion Air Study

This study considered the combustion air requirement for an oil-fired boiler and the isolation of the combustion air zone (CAZ) from the house required to avoid back-drafting in the boiler. Based on observations at four houses, it appears that a boiler, rated at approximately 150,000 BTU/hour, located in a two-car garage needs a minimum of a four-inch diameter duct for combustion air and about a 6-inch diameter duct to provide protection against back-drafting. Specifically, the leakage area between the CAZ and the house should be less than the leakage area between the CAZ and outdoors. There was no back-drafting when the ratio of these leakage areas was about 1:10. A smaller air combustion duct reduces the risks of freezing in a boiler room. CCHRC staff met with individuals on the City of Fairbanks Code Review Board and presented data collected from this study on combustion air requirements for oil-fired boilers. This information was incorporated in new code requirements and adopted as an amendment to the 2000 International Mechanical Code. The final report for this study is available on our website at Research + Projects > Reports > Research Reports > RR 2003-01.
2007 marked the first full calendar year CCHRC operated the state of the art Research and Testing Facility (RTF).

The RTF is a foundational part of the CCHRC strategic and business plans because it provides office and lab space for CCHRC and its partners to manage and carry out core research, product development and testing, and technology transfer relationships with the university, building scientists, building industry partners, and home building associations across the state and the nation. The RTF also includes classroom, library, meeting, and demonstration space in further support of CCHRC’s research agenda.
Research and Testing Facility Features

**Monitoring Systems:** Monitoring stations are located throughout the building. These stations contain complex electronic recording instruments which record what is happening throughout the building in the ceiling, walls, windows, and foundation.

**Walls and Roof:** The building wall system is constructed using the Residential Exterior Membrane Outside Insulation Technique (REMOTE). Developed to resist moisture intrusion and condensation in the wall cavity, eliminating mildew, rot, and mold, this system is effective in the cold interior temperatures and in the wet and temperate weather of Southeast Alaska. The walls of the facility are rated R 40 and the roof is rated at R 60.

**Network Infrastructure:** The CCHRC information network is composed of approximately 3.5 miles of Augmented Category 6 cabling, running to about 90 locations throughout the building. Our open source Private Branch Exchange (PBX), secure services gateways, 1 Gb/s Ethernet switches, and wireless equipment all support the quality of service required for data, voice, and video integration using VoIP.

**Information Systems:** The information and computing system implementation is designed to help ensure the reliability and integrity of CCHRC’s research and testing data. We are in the process of setting up an automatic data backup system and interactive information system for Web, as well as wall-mounted, display access to CCHRC’s on-going research and published results.

**Water Systems:** From the green roof to the black-water sewage treatment plant in the basement, the water systems are designed to minimize water usage, with adjustable flush toilets, waterless urinals, and automatic sinks. Four 1000-gallon water tanks in the basement hold drinking water, grey water, and rainwater. A self-contained sewage treatment plant handles black water materials.

**Foundation:** The building site has permafrost at a depth ranging from 12’ to 28’ below the facility. The site was pre-loaded with one and a half times the facility’s weight to compact it in preparation for the weight of the building. The foundation is ready to compensate for any movement with integral piers that allow the entire building to be raised with 50-ton jacks and leveled by the injection of grout or structural foam.

**Masonry Heater:** This 12,000 pound wood-fired heater will not only provide gentle, long lasting radiant heat, it will also be used to test the relative efficiency of various types of wood as fuel.

**The Builders Resource Library:** In collaboration with the National Association of Home Builders (NAHB) a broad array of texts and technical materials will be available to those who visit the RTF on site and on-line. Visitors will be able to access CCHRC’s latest research, the UAF’s Rasmuson Library’s on-line collections, and the NAHB’s on-line library.

**Boiler Room/Radiant Heat systems:** Three high-tech oil fired boilers provide hydronic heat in the labs and radiant heat in the floors of the administrative office wing. Each is being monitored to determine its degree of efficiency—a measure important for both economic and environmental reasons.

**Cooperative Extension Service (CES):** CES’s presence within the facility demonstrates the collaborative research relationship between the two organizations. CES serves as a resource for education and outreach as well.

**South Lab:** The UAF Institute of Northern Engineering leases the South Lab. This lab was designed for structural testing. It has a reinforced ‘strong’ floor so heavy beams can be tested, bent or broken.

**North Lab:** This is the heart of CCHRC’s product development and testing, continuing the Center’s practice of partnering with private businesses and public agencies.

**Gardens and Landscaping:** Native plants have been used extensively to reduce water requirements. The ground surface was shaped to allow the pond to accumulate all of the storm water runoff from the surrounding area. Experimental plots on the roof are testing which varieties of plants are hardy in this environment. The vegetation on the roof also stores rainwater and slows its flow from the site.

**Lighting:** All CCHRC employees have an office that is open to natural light. The system monitors the ambient lighting and adjusts to maintain good lighting levels throughout the day.

**Ventilation:** HRV equipment takes warm air from within the building and exchanges it for fresh outside air. Heat from the exiting air pre-heats the incoming air prior to circulation. The system measures and adjusts for CO2 levels and occupancy loads. It can be set to run internal air only, employing an interior filtration system, providing a healthier inside air quality when there is ice fog or smoke outside.
CCHRC’s Wood Energy Project commenced in March of 2007 and has been steadily gaining momentum and public interest.

Through most of 2007 heating oil was over $3.00 per gallon, which sparked interest in renewable energy sources, and the interest in heating with wood has risen to a level not seen since the 1970’s. This is especially true in Alaska were heating demands are high. Part of CCHRC’s ongoing research is to identify and test new (and some very old) technologies and demonstrate how they can be successfully applied to both new and existing homes in order to reduce the use of non-renewable fuels. The good news is that wood-burning technology has improved dramatically since the 1970’s, and there are now many very efficient and low-emissions systems to choose from. New products and appliances continue to become available and it is CCHRC’s goal to remain informed about advances in this field.

CCHRC will be installing various wood-burning appliances at the Research and Testing Facility (RTF) in order to demonstrate potential wood heating solutions. This will be in conjunction with the development of a wood-heating appliance testing and certification program that will highlight technologies appropriate for the northern environment. This program will provide homeowners with practical product information based on performance in our specific environment. This type of product information is very important to consumers considering installing these systems given their substantial up-front cost and the complexity of advertised performance ratings.

Additionally, CCHRC will install a Combined Heat and Power (CHP) unit as the wood energy component of its Hybrid Micro-Energy Project (HMEP) here at the Research and Testing Facility. In our northern environment, an appliance that produces both heat and electricity from burning woody biomass is an important part of an integrated energy system. This portion of the system will fulfill heating and electrical demand during periods when direct solar energy is not sufficient to meet demand. A goal of CCHRC is to produce more energy than our facility needs, making it a “Net Zero Energy” building, and supply excess electrical energy to the grid as an available renewable source.

CCHRC’s Wood Energy Project continues education and outreach through the public’s visits to CCHRC, as well as programs and lectures such as “Biomass Energy Research and Development at CCHRC” presented at the Alaska Wood Energy Conference held in Fairbanks, Alaska on November 15, 2007 and “Wood Heat- An Alternative to Oil?” presented at the University of Alaska Fairbank’s Museum of the North Lecture Series on December 6, 2007.

To learn more about Wood Energy visit:
www.cchrc.org/wood energy.html

Website Content:
Presentation to the Wood Energy Conference
Presentation in the UAF Lecture Series
Snapshot RS 2007-08
The Hybrid Micro-Energy Project (HMEP) is a milestone achievement for CCHRC.

The Hybrid Micro-Energy Project (HMEP) consists of four solar photovoltaic (PV) tracking arrays which generate 10 to 15 kilowatts of electricity, two solar thermal systems, at least one biomass combined heat and power (CHP) system, and the monitoring of off-site wind generation data. The solar PV tracking arrays were installed in the fall of 2007 and officially commissioned on December 21, 2007—the winter equinox. The solar thermal systems are ready for final installation and commissioning is expected in the spring of 2008. CCHRC opted to issue a request for proposals to identify the most suitable biomass CHP unit(s) and received several responses. CCHRC will reach a decision on which technology will work best in Alaska in early 2008. Several sites in the interior have been identified to collect wind power generation data, and CCHRC is in the process of establishing protocols for data collection and display.

The testing and development of energy production systems combined with robust and transparent data collection will provide the confidence needed to move away from the ubiquitous and unsustainable diesel genset.

Project Partners

- The Fairbanks North Star Borough (FNSB)
- The BP Foundation
- The State of Alaska
- Siemens
- GW Scientific
- Remote Power Incorporated
- The University of Alaska Fairbanks
- EEInternet
- The Cooperative Extension Service
- Golden Valley Electric Association
The purpose of this three day forum was to discuss approaches to developing sustainable buildings and communities in the Arctic. The Forum was the result of an alliance of private and public sector organizations with the shared vision of bringing together the most outstanding minds from around the circumpolar north to address northern building science and technology, energy and alternative energy systems, and appropriate sustainable design of buildings and communities.

Addressing these immense challenges demands international action and collaboration in both the public and private sectors. To enhance the connections and involvement in the circumpolar north the forum was web-conferenced. This technology allowed viewers from around the world to take part in the event and engage in a constructive dialogue.

Everyone who attended, either in person or through the internet is able to continue this dialogue on the forum website at www.cchrc.org/forum.html. The Forum website also contains a report including a research agenda and suggested action items for appropriate, effective approaches to sustainability, which fall into four different categories: education, demonstration, implementation, and financing.

The challenges those of us who live in these beautiful Northern regions face demands proactive and immediate action. There is a shared passion among us to create a sustainable living environment, meeting the needs of the present without compromising the ability of future generations to meet their needs. The forum was a step in that direction. It will take many more for the vision to become a reality. With everyone’s effort it will be possible.
## CCHRC Research:
A compendium of past, present, and future research projects.

### Current Projects
- State of Alaska End-Use Energy Efficiency Study
- AKWARM Rewrite
- BEES Revision
- Regional Housing Authority Technical Support
- Hybrid Micro-Energy Project
- Masonry Heater Efficiency Study
- Wood Burning Technology
- Frost Protected Shallow Foundation Study
- Alaska Green Building Initiative
- Research and Testing Facility Initial Building Envelope Analysis
- Legacy Monitoring
- Mobile Test Lab II

### Completed Projects
- Building America in Alaska
- Building America in Alaska II
- BEES Survey
- Four Star Plus, Five Star, and Five Star Plus Energy Rated Homes Survey and Analysis
- Healthy Homes in Alaska
- Healthy House VOC Monitoring
- Evaluation of Ventilation Systems with Regard to Indoor Air Quality
- Mold Survey
- Kenai Indoor Air Quality Study
- Cook Inlet Housing Authority – Mountain View Housing Study
- South Central Ventilation Study
- Oversizing of Residential Heating Systems
- Combustion Air Study
- Improve the AKWarm Design Heat Loss Calculation
- Statewide Housing Survey
- Remediation of Smoke Particles in Fairbanks Homes
- Straw Bale House Monitoring
- REMOTE Wall Study
- Mobile Test Lab - Wall Systems for Southeast Alaska
- Permafrost under the RTF

### Proposed Projects
- Sustainable Northern Shelter
- Built Environment Energy Efficiency Program
- Energy Extension Pilot Program For Rural Alaska
- Investigating Potential Applications of Environmentally Friendly Inorganic Cements to Cold Climate Construction
- Applying New Materials and Technology to Alaskan Building Envelope Retrofitting
- Develop New Foundation Systems for Soils Underlain by Permafrost
- Application of Alaskan Coal Ash Geopolymers to Cold Climate Construction
State of Alaska End-Use Energy Efficiency Study

Description:
This project will provide a comprehensive review and analysis of the energy efficiency policies and programs of the State of Alaska. The project will focus on end-use efficiency for meeting space-heating and electric power needs in the residential and commercial sectors. While the scope is statewide, emphasis will be placed on the railbelt and communities along the road system in consideration of the existence of the Rural Energy Plan. CCHRC will provide a set of recommended actions that the State can take to improve its energy efficiency policies and programs. The main goal for improving these policies and programs is to achieve a cost-effective reduction in the energy demand density. We anticipate this reduction in demand density to also be associated with reduced energy costs, pollution, and greenhouse gas emissions, an improved economy, better health for all Alaskans, and more sustainable and secure communities.

Status:
An interim set of recommendations pertinent to the proposed Railbelt Energy Plan will be completed during the 2008 legislative secession for the consideration of the legislature and the governor. The final report will be due in June, 2008.

Funding Source:
This project is funded by AEA and AHFC; CCHRC is the project manager. CCHRC issued an RFP and subsequently awarded the project to Information Insights.

AKWarm Rewrite

Description:
CCHRC is reviewing the AKWarm software which is currently used in the planning stage of a house to project the energy usage. An assessment of additional features to be added is being made. Any modifications required by the current effort to re-write BEES will also be included. The result of these processes will be a scope of work document for the next phase of AKWarm development and an associated request for proposals. Depending upon the responses to the RFP we will likely negotiate a small consulting contract with the original author of AKWarm.

Status:
The first phase of the project is complete. An RFP was issued and proposals are being reviewed. More information can be found on our website (www.cchrc.org) under Research and Projects > Reports > Informational Reports > IR 2007-01, AkWarm Energy Rating Program Evaluation

Funding Source:
Alaska Housing Finance Corporation
BEES Revision

Description:
AHFC tasked CCHRC with making recommendations for updating Building Energy Efficiency Standard. CCHRC organized a work group that reviewed the existing BEES changes that were proposed in the previous review, other suggestions that had been made to AHFC, the new ASHRAE residential ventilation standard, and the International Energy Conservation Code (IECC). While the BEES applies only to issues under AHFC purview, we also took note of the process undertaken by ASHBA to consider a statewide building code, in particular the fact that the group had determined to use the International Residential Code as the basis for their work. This project also supported basic revisions of AK-Warm to keep it consistent with the new versions of BEES.

Status:
Up-to-date AHFC BEES Regulations can be found at http://www.ahfc.state.ak.us/regulations/155_010.cfm. Alaska Amendments to IECC 2006 and ASHRAE 62.2-2004 can be found on our website (www.cchrc.org) under Research and Projects > Reports > Informational Reports > IR 2006-04, BEES - Alaska Specific Amendments to IECC 2006. The amendments are to be read along with the documents that they amend, namely the International Energy Code 2006 and the ASHRAE Standard 62.2-2004 Ventilations and Acceptable Indoor Air Quality in Low-rise Residential Buildings. CCHRC continues to support AHFC in their fine tuning of these changes.

Funding Source:
Alaska Housing Finance Corporation

Regional Housing Authority Technical Support

Description:
CCHRC has ongoing involvement with regional housing authorities to respond to requests which address issues of concern to the Housing Authorities. In some cases projects are submitted to AHFC for funding consideration and approval. The Cook Inlet Housing Authority - Mountain View Housing Study (see page 30) and the HUD funded Mold Survey (see page 29) study are past examples. CCHRC staff have also participated in several mold remediation training for employees of Alaska Native Housing Authorities in Anchorage and Fairbanks and have also visited housing managed by the Alaska Housing Authorities around the state.

Status:
CCHRC continues to be involved with Regional Housing Authorities. We is currently working with TNHA to develop a model for building affordable, energy efficient, and sustainable homes for Alaskan villages and discussing with IRHA the development of a hybrid renewable energy system for rural communities.

Funding Source:
Alaska Housing Finance Corporation
Hybrid Micro-Energy Project

Description:
The CCHRC initiated the Hybrid Micro-Energy Project (HMEP) to demonstrate how a mix of renewable energy sources can work together to meet small scale energy demands in Alaska on a year round basis. The hybrid system is designed for the high-latitude challenge of minimal solar energy during the long winter when energy demand is greatest and bountiful solar energy in the summer when demand is minimal. The HMEP will greatly contribute to CCHRC’s goal of a net zero energy Research and Testing Facility. (See page 16 for more information).

Status:
Solar PV is installed and operational and full commissioning occurred on the winter solstice, December 21, 2007. Solar thermal systems are installed on the roof of the RTF and storage tanks have also been installed. We plan to commission the solar thermal hot water system in March 2008. The biomass combined heat and power (CHP) RFP responses have been received and are under review; a decision is expected in early 2008 with installation to follow in fall of 2008. The wind generation site(s) have been selected and the data acquisition system is being established.

Funding Source:
Contributors to the HMEP include the BP Foundation, the Fairbanks North Star Borough, the State of Alaska, Siemens, GW Scientific, Remote Power Incorporated, University of Alaska Fairbanks, EEInternet, the Cooperative Extension Service, and Golden Valley Electric Association.

Masonry Heater Efficiency Study

Description:
CCHRC has contracted with Solutions to Healthy Breathing to develop a protocol for measuring the efficiency and pollutants from wood burning heaters such as a wood stove or masonry heater and to apply this protocol to a masonry heater recently built here in Fairbanks. The contractor met with representatives from the Masonry Heater Association of America and EPA to reach an agreement on the measurement protocol. Measurements were made last winter and will continue this heating season. The masonry heater in the RTF is also being monitored this winter.

Status:
The final report is written, and the project is due for completion in March, 2008. It will be available online.

Funding Source:
Alaska Housing Finance Corporation
Wood Burning Technology

Description:
As a first step toward developing practical wood energy solutions for urban and rural Alaska, we have hired a wood energy specialist, Dave Misiuk, to work with us in researching, developing, and testing a variety of wood-burning technologies and products that could be the basis for local enterprises. We anticipate that the first year of this project will be spent evaluating promising technologies and will culminate in a report and project plan for the second year. The report will detail the advantages and disadvantages of the various technologies investigated. The project plan will specify which technologies are the most promising and a program for testing and demonstrating these promising technologies over the second year of the project. This project also received additional funding in 2007 from the Fairbanks North Star Borough for more work on CHP development, biomass project development at the borough landfill and consulting work.

Status:
The interim first year report will be available in late March 2008. For more information see: www.cchrc.org/wood energy.html.

Funding Source:
Fairbanks North Star Borough
State of Alaska
Frost Protected Shallow Foundation Study

Description:
CCHRC will install and monitor five thermocouple strings at each of two houses. The basic idea behind frost-protected shallow foundations (FPSF) is that suitable insulation placed outside of the shallow (hence, less expensive) foundation can protect it from heaving due to seasonal freezing. Scandinavian countries have been using this technique for many years and there is guidance in the International Residential Code for FPSF for regions with air-freezing indexes up to 4000-degree-Fahrenheit days. Many areas in Alaska exceed this index. Mr. Paul Perreault, in making this study his thesis project, will be collecting isotherm data from the soil under actual houses, comparing that data to the results of computer modeling, and writing a draft specification for the FPSF for inclusion in residential codes that would apply at air freezing indexes appropriate to Interior and Northern Alaska.

Status:
Paul Perreault’s thesis work will take four years. In the meantime, a CCHRC Snapshot is available on our website (www.cchrc.org) under Research and Projects > Reports > Snapshots > RS 2006-02, Frost Protected Shallow Foundation Interim Report.

Funding Source:
Alaska Housing Finance Corporation

Alaska Green Building Initiative

Description:
The Alaska State Home Building Association (ASHBA) has created a Green Building Committee. The ASHBA Green Building Committee met during the ASHBA convention in Girdwood, Alaska in November, 2007 to discuss the state-wide implementation of the National Association of Home Builders’ (NAHB) proposed Green Building Standards through local home builder associations. Subsequent to that meeting, CCHRC has been in contact with the NAHB Research Center regarding their creation of a new ANSI/NAHB Green Building Standard. These new Green Building Standards will be unveiled at the International Builders’ Show in Orlando, Florida in mid-February, 2008. These new Green Building Standards will be made regionally appropriate by the NAHB Research Center based on zip codes. CCHRC has been requested to assist ASHBA with implementing the new NAHB Green Building Standards state-wide.

Status:
CCHRC has established a new project to develop a presentation to present these new standards statewide.

Funding Source:
Alaska Housing Finance Corporation
Research and Testing Facility
Initial Building Envelope Analysis

Description:
CCHRC contracted with GW Scientific and the University of Alaska to perform an initial analysis of selected sets of data collected using the over 1000 sensors in the RTF. CCHRC is maintaining the data acquisition systems, archiving the data, and making some subsets of the data available online. The initial phase of this project will include analysis and comparison of the following: REMOTE wall and roof sections; foundation, soil and water table; green roof and rainwater catchment systems; cold-weather concrete performance; and thermal analysis.

Status:
UAF completed an overall analysis of the thermal performance of the RTF. Snapshots and live-streaming data are available on our website (www.cchrc.org) under Research and Projects > Reports > Snapshots > RS 2007-09, Cold Weather Concrete Demonstration and RS 2007-10, Green Roof Hydrology During Spring 2007 Break-up. Analysis of the wall and roof data is ongoing.

Funding Source:
Alaska Housing Finance Corporation

Legacy Monitoring

Description:
The RTF itself is a model to learn from and provide data and research on building performance—to this end, more than 1000 sensors have been installed in the building to make it a living demonstration of building system operations and performance. CCHRC is collaborating with GW Scientific on this project to produce the following products, which will form the foundation for the RTF Legacy Monitoring Program:
- Report summarizing brainstorming, data gathering, and synthesis efforts
- METADATA Guidelines Manual
- Data Quality Assurance and Quality Control Manual
- Data Network Operations and Maintenance Guide
- Report on educational, training, and outreach recommendations and examples

The outcomes of this effort will be an optimization of the current monitoring plans into a long-term program. The RTF Legacy Monitoring Program will also serve as a foundation for evaluation of future proposal and funding efforts.

Status:
The final report is slated to be completed and delivered to CCHRC in February 2008.

Funding Source:
Alaska Housing Finance Corporation
Mobile Test Lab II: Wall Systems for Southeast Alaska

Description:
CCHRC contracted with the University of Alaska Southeast to continue Marquam George’s work in testing wall sections for Southeast Alaska in CCHRC’s Mobile Test Lab. Balanced Solutions provided the data logging design, equipment acquisition, and set up. This study was designed to expand on the results from the previous testing (MTL I, see page 35). The goal is to evaluate different combinations of the exterior insulated wall system for both commercial and residential applications. Each of the test walls was outfitted with a series of temperature, relative humidity and wood moisture sensors. Two wetting systems were installed to simulate leaks from the window on the interior and on the exterior side of the sheathing. Injecting water into the wetting system provides a method of evaluating and comparing the response of wall systems to a carefully controlled simulated leak. Boundary conditions during testing were monitored with the aid of two weather stations mounted on the test trailer. The weather stations included wind direction and speed, horizontal and driving rain, exterior temperature and relative humidity, and a solar radiation sensor.

Status:
The final report for this study can be viewed on our website at: Research & Projects > Reports > Research Reports > RR 2006-01, Mobile Test Lab - Wall Systems for Southeast Alaska.

Funding Source: Alaska Housing Finance Corporation
Building America in Alaska

Description:
The primary goal of this project was to develop plans for energy efficient, durable, healthy, and cost effective homes affordable to moderate income Alaskans. The team designed a single-family residential home with modifications for each of three major climatic regions/environments found in Alaska. Building America homes using the CCHRC design were constructed by Bee Construction in North Pole, Alaska, and Blu-Spruce Construction in Juneau, Alaska. These homes were readily accepted in the marketplace and sold upon or prior to completion. The performance target for these homes is Five Star Plus, which is the highest level of efficiency.

Status:
The Final Report was completed in 2001 and included building design, material list, construction costs, and performance testing and energy modelings. CCHRC staff worked with the greater Fairbanks Area Habitat for Humanity to incorporate the Building America design and technology in their projects. The Alaska team and CCHRC staff reviewed the Building America program’s “Builders Guide: Cold Climates” and recommended updates to the Building Science Consortium. A full set of plans are available on our website under Research and Projects > Reports > Building America in Alaska House Plans.

Funding Source:
U.S. Department of Energy
Alaska Housing Finance Corporation

Building America in Alaska II

Description:
The goals: 1) develop builder’s education courses on BAA approaches and continue education and promotion of Building America techniques for the Alaskan building industry; 2) testing and monitoring of the Building America houses constructed in Alaska in 2001; and 3) develop a Building America strategy to address the cold, wet climate of Southeast Alaska, including construction of a test module for testing wall panels for moisture, durability, and energy efficiency.

Status:
CCHRC prepared a PowerPoint presentation of the 4 hour class and a final report. The final report can be viewed on our website under Research and Projects > Reports > Research Reports > RR 2004-01, Building America in Alaska. The CCHRC Mobile Test Lab (MTL) was constructed in North Pole and shipped to Juneau in January 2003. For more information on the MTL see Lessons from CCHRC Research on page 9 of this report.

Funding Source:
U.S. Department of Energy
BEES Survey

Description:
CCHRC contracted with Northern Economic Research Associates (NERA) to undertake an economic analysis of the proposed changes to the Building Energy Efficiency Standards (BEES). The analysis included life cycle costs of compliance including initial construction costs and long-term maintenance costs. Direct benefits were measured through improvements in energy efficiency, health or safety related impacts consequent to air quality and other environmental improvements, as well as changes in structural durability and occupancy comfort. Indirect economic impacts on community employment resources, and availability of housing were also considered.

Status:
NERA completed the survey and the Final Report was forwarded to Alaska Housing Finance Corporation. A summary report can be found on our website (www.cchrc.org) under Research and Projects > Reports > Research Reports > RR 2001-01, Building Energy Efficiency Standards (BEES) Survey Summary.

Funding Source:
Alaska Housing Finance Corporation

Four Star Plus, Five Star, and Five Star Plus Energy Rated Homes Survey and Analysis

Description:
CCHRC contracted with Ivan Moore Research (IMR) to conduct a customer survey of Four Star Plus and Five-Star Plus homes to determine customer satisfaction and understanding of building components.

Status:
IMR has completed the survey and evaluated and analyzed the energy use data (actual vs. energy rating estimates). The executive summary of the survey results can be found on our website (www.cchrc.org) under Research and Projects > Reports > Research Reports > RR 2002-01, Energy Efficient Housing Survey: Executive Summary.

Funding Source:
Alaska Housing Finance Corporation
Healthy Homes in Alaska

Description:
The Alaska Housing Finance Corporation (AHFC) partnered with the Cold Climate Housing Research Center (CCHRC) to conduct Healthy Homes project activities in Fairbanks and in Hooper Bay. The purpose of the Healthy Homes Initiative was to demonstrate cost effective, preventive measures to correct health hazards in the home environment that produce serious upper respiratory illness in children. This was a two-year project that included the University of Alaska and state weatherization agencies. The Healthy Homes project increased the services of the weatherization program to include addressing the sources of moisture in the home and the removal and replacement of water-damaged materials and furnishings. It also assessed the effect of resultant changes in indoor air quality on the health of the residents. Whether and how older housing can be successfully remediated, or whether housing funds should be prioritized to new housing is an important decision for AHFC and Housing and Urban Development (HUD).

Status:
A Final Report was sent to HUD in March 2005 and is available from CCHRC on a CD. The executive summary is available on our website under Research and Projects > Reports > Research Reports RR 2005-03, Healthy Homes Executive Summary.

Funding Source:
HUD
Alaska Housing Finance Corporation

Healthy House VOC Monitoring

Description:
CCHRC contracted with Alaska Energy Associates (AEA) for data collection of Volatile Organic Compounds (VOC) in various new homes in Fairbanks and Juneau. The purpose of this project was to assess the effect that different ventilation strategies have on indoor air quality. The study dwellings in both communities included a “Healthy House,” a non-mechanically ventilated 5 Star home, and a 5 Star-Plus home with a heat recovery system for ventilation. The Fairbanks “Healthy House” tested is also a Habitat for Humanity house. Testing took place pre-occupancy, soon after occupancy began, and 6 months following occupancy.

Status:
The final report is available on our website under Research and Projects > Reports > Research Reports > RR 2004-02, Monitoring of Volatile Organic Compounds in Alaska Health Houses.

Funding Source:
Alaska Housing Finance Corporation
Evaluation of Ventilation Systems with Regard to Indoor Air Quality

Description:
The CCHRC contracted with Alaska Building Science Network (ABSN) to monitor 100 relatively new homes in 3 different climatic regions in Alaska (Anchorage/Matsu, Juneau, and Fairbanks). Monitoring consisted of relative humidity, particulates, and VOC’s. The goal of this study was to provide an evaluation of the extent to which various factors, including ventilation strategies, house characteristics and location, and occupant usage affect indoor air quality. Additionally, ABSN obtained thirteen carbon monoxide data loggers from the Municipality of Anchorage and included benzene in their testing.

Status:
The research is complete and the final report is available on our website (www.cchrc.org) under Research and Projects > Reports > Research Reports > RR 2002-03, Indoor air quality and ventilation strategies in new homes in Alaska.

Funding Source:
Alaska Housing Finance Corporation

Mold Survey

Description:
In early March, 2003, CCHRC, under contract from the Housing and Urban Development (HUD) Office of Native American Programs, began a rapid survey of mold problems in Alaska native housing. In total, we documented over 1700 apartments or homes that had some level of mold problem. These likely vary from mild mildew around windows, in kitchens, or in bathrooms, to severe mold development that will require the destruction of the building. HUD recognizes the seriousness of this issue and is providing training to Alaska native housing workers around the Nation. CCHRC also provides consulting services on a variety of housing issues, including low-cost ventilation systems. Adequate ventilation is one of the keys, along with good moisture control, to maintaining a healthy, mold-free home.

Status:
The mold survey is complete and the final table can be viewed on our website under Research and Projects > Reports > Informational Reports > IR 2003-02, Alaska Mold Survey.

Funding Source:
Housing and Urban Development
Kenai Indoor Air Quality Study

Description:
This study is designed to find solutions to some of the most common causes of indoor air quality problems in South-central Alaska. CCHRC contracted with Wisdom and Associates to monitor 100 homes during the 2003-04 winter. The homes with suspected indoor air quality problems were monitored for carbon monoxide, carbon dioxide, temperature, relative humidity and radon. Each home has also undergone a BEES ventilation check, ultra fine particle sweep and a pressure imbalance testing.

Status:
The final report is being edited and will be available online soon. The report will present data from all homes investigated, an analysis of trends or patterns that lead to poor indoor air quality, and recommended solutions.

Funding Source:
Alaska Housing Finance Corporation

Cook Inlet Housing Authority: Mountain View Housing Study

Description:
The project included commissioning of mechanical systems (ventilation and heating), determination of heating system efficiency and total cost to operate, measurement of IAQ and thermal comfort parameters, measurement of humidity and temperature in the attic and crawl spaces, and calculation of an energy rating for each house including pressure testing and duct leakage measurements. The final report summarizes monitoring results and building performance, identifies systems that are performing well, and provides recommendations on systems or strategies that could be improved.

Status: An interim report is available on our website (www.cchrc.org) under Research and Projects > Reports > Informational Reports > IR 2006-02, Cook Inlet Housing Authority Interim Report, and a CCHRC Snapshot is available under Research and Projects > Reports > Snapshots > RS 2007-01, New Home Study for Cook Inlet Housing Authority.

Funding Source:
Cook Inlet Housing Authority
Alaska Housing Finance Corporation
South Central Ventilation Study

Description:
In response to a request from the Anchorage Research Advisory Committee, CCHRC commissioned John Freeman of Sunrise Energy Works to study the Skuttle ventilation technique in new housing in the Anchorage area during the winter and spring of 2004. This study monitored nine houses in a new subdivision to assess the effectiveness of their Skuttle ventilation system and their “as is” compliance with the Alaska Building Energy Efficiency Standard (BEES) ventilation requirements. The study compared the total effective ventilation rate calculated from measurements in each house to the BEES requirement. Each house in the study has a furnace-fan-integrated supply duct (Skuttle) and bathroom exhaust fans. During the study, motor loggers monitored the runtimes of the furnace and the bathroom fans. These fan runtimes and initial airflow measurements provided estimates of the mechanical ventilation rate in each house. Blower door tests were used to estimate the natural air leakage contribution. Results were used to calculate the daily averages of the total effective ventilation rate. All of the houses were occupied, and data recorded reflected the occupants’ normal living patterns. Without a linkage between the furnace and bathroom fans this system did not consistently provide an adequate amount of fresh air.

Status:
The report is available on our website (www.cchrc.org) under Research and Projects > Reports > Research Reports > RR 2005-01, South Central Ventilation Study.

Funding Source:
Alaska Housing Finance Corporation

Over-sizing of Residential Heating Systems

Description:
CCHRC contracted with Arctic Energy Systems (AES) to measure the actual design heat load of houses by monitoring the runtime of the furnace in relation to outdoor temperatures. The study monitored 20 houses in the Anchorage area during the very cold weather. The goal of this study was to better determine appropriate heating system sizing for the HVAC industry to reduce building costs and improve the efficiency and comfort of homes.

Status:
The final report is complete and available on our website (www.cchrc.org) under Research and Projects > Reports > Research Reports > RR 2002-02, Over-Sizing of residential forced air heating systems in Southcentral Alaskan Homes.

Funding Source:
Alaska Housing Finance Corporation
Combustion Air Study

Description:
This study considered the combustion air requirement for an oil-fired boiler and the isolation of the combustion air zone (CAZ) from the house required to avoid back-drafting the boiler. Based on observations at four houses, it appears that an approximately 150,000 BTU/hour boiler located in a two-car garage needs a minimum of a four-inch diameter duct for combustion air and about a 6-inch diameter duct to provide protection against back-drafting. Specifically, the leakage area between the CAZ and the house should be less than the leakage area between the CAZ and outdoors. There was no back-drafting when the ratio of these leakage areas was about 1:10. CCHRC staff met with individuals on the City of Fairbanks Code Review Board and presented data collected from this study on combustion air requirements for oil-fired boilers. This information was incorporated in new code requirements and adopted as an amendment to the 2000 International Mechanical Code. The final report for this study is available on our website at Research + Projects > Reports > Research Reports > RR 2003-01

Status:
A draft final report is undergoing review & editing. CCHRC staff met with individuals who are reviewing codes for the City of Fairbanks Code Review Board and presented data collected from this study on combustion air requirements for oil-fired boilers. This information was incorporated in new code requirements and adopted as an amendment to the 2000 International Mechanical Code.

Funding Source:
Alaska Housing Finance Corporation

Improve the AKWarm Design Heat Loss Calculation

Description:
CCHRC contracted with Arctic Energy Systems to develop computer software that calculates the design heating load of a home, so that the home’s heating system is properly sized. The software presents the results in an industry-accepted report. The software is operated via the user’s Internet web browser and is freely accessible to all users across the Internet.

Status:
The heat loss calculator is available for testing on our website (www.cchrc.org) under Research and Projects > Reports > Best Practices Reports > BPR 2003-01, Link to Design Heat Loss Calculator.

Funding Source:
Alaska Housing Finance Corporation
Best Management Practices for Rain Catchment Systems in Alaska

Description:
CCHRC developed a project with the Institute of Northern Engineering/Water and Environmental Research Center to prepare a best management practices (BMP) in regard to materials and methods of rain catchment systems for domestic water collection, storage, and distribution.

Status:
A final report is available on our website (www.cchrc.org) under Research and Projects > Reports > Best Practices Reports > BP 2003-03, List of Approved Materials for Rainwater Catchment Systems in Alaska.

Funding Source:
Alaska Housing Finance Corporation

Statewide Housing Survey

Description:
This project updated and extended the 1991 Housing Needs Assessment Study conducted by the ASK* Marketing Research Group for the Department of Community and Regional Affairs. CCHRC hired Information Insights to assemble the 2000 Census Data and other data sources and conduct an additional survey to fill any gap.

Status:
The final report with survey results is available on our website (www.cchrc.org) under Research and Projects > Reports > Research Reports > RR 2005-02, Statewide Housing Survey Executive Summary.

Funding Source:
Alaska Housing Finance Corporation

Remediation of Smoke Particles in Fairbanks Homes

Description:
This summer 2004 project was initiated in response to and in the midst of the heavy smoke in the Fairbanks area due to wildfires. Bill Reynolds of Solutions to Healthy Breathing and Cathy Cahill of the University of Alaska Fairbanks conducted an emergency study to improve indoor air quality and address simple and affordable filtration strategies. Systems were installed in houses of people with a history of respiratory problems; the filtrations systems used resulted in significantly improved air quality.

Status:
The report is available on our website under Research and Projects > Reports > Informational Reports > IR 2004-01.
Straw Bale House Monitoring Project

Description:
CCHRC conducted in-house monitoring of three straw bale houses in the Fairbanks area. The monitoring project consists of measuring temperature and moisture gradients throughout the straw bale insulation of the exterior walls. CCHRC staff inspected the vapor barrier during construction and performed blower door tests. Indoor and outdoor air temperatures and wind velocity and direction are being monitored to verify induced moisture levels.

Status:
A presentation illustrating the construction of five straw bale structures in Fairbanks is available on our website (www.cchrc.org) at Research and Projects > Reports > Information Reports > IR 2003-03, Straw Bale Building in Alaska. The final draft of the literature search and best practices report will be available soon. We are also currently working on a report incorporating collected data.

Funding Source:
Alaska Housing Finance Corporation

REMOTE Wall Study

Description:
In 2002, CCHRC undertook a simple study of the performance of two residential dwellings built with different wall systems. One was a standard wall system with an interior vapor/air barrier and the other was a modified PERSIST wall that has been named “REMOTE” which stands for Residential Exterior Membrane Outside Insulation Technique. This was a short-term data collection period as the buildings were monitored from the first of December 2002 through March of the same year. The results of this short term data collection period can really only be used to predict possible long term performance and should not be construed to imply a thorough evaluation of wall system performance of the building over a substantial period of time.

Status:
The final report and a snapshot are available on our website under Research and Projects > Reports. The final report is catalogued under Research Reports > RR 2005-04, REMOTE Wall system. The snapshot is catalogued under Snapshots > RS 2007-03, REMOTE Wall System.

Funding Source:
Alaska Housing Finance Corporation
Completed Projects

Mobile Test Lab – Wall Systems for Southeast Alaska

Description:
CCHRC contracted with University of Alaska, Southeast to continue Marquam George’s work in testing wall sections appropriate to SE Alaska in CCHRC’s Mobile Test Lab. The data logging design, equipment acquisition and set up were contracted to Balanced Solutions.

Status:
The final report is available on our website under Research and Projects > Reports > Research Reports > RR 2006-01, Mobile Test Lab - Wall Systems for Southeast Alaska.

Permafrost Monitoring Under the RTF

Description:
The permafrost table beneath the Cold Climate Housing and Infrastructure Research and Test Facility (RTF) is being monitored. Water table observation wells were drilled and surveyed, and subsidence markers placed and surveyed prior to pre loading of the RTF building footprint. Two thermistor strings have been installed in 20 foot deep, cased holes. A new multiplexer was purchased and installed in an existing modem. A radio transmitter is used to store and transmit the permafrost data through the Fairbanks Mesonet for real-time display on the Internet along with data from the CCHRC weather station. These real-time data constitute the report for this project.

Status: The equipment has been installed and the real time data is available on our website (www.cchrc.org) at Research and Projects > Reports > Informational Reports > IR 2996-01, Permafrost Monitoring--RTF Link.

Funding Source:
Alaska Housing Finance Corporation
Proposed Projects

Sustainable Northern Shelter

Description
The “Sustainable Northern Shelter” Project is an opportunity to create a productive partnership to design and construct two or more demonstration homes using an approach that partners with an Alaska Native community to develop a culture-based design. Incorporated in that design will be locally available materials, an energy efficient and durable building envelope, economical and advanced heating and ventilation systems, innovative water storage and wastewater treatment, renewable energy systems that utilize available resources, and the use of local labor for construction with a targeted cost of $100,000.

The preliminary design is to be built and tested in Alaska, possibly at Toolik Field Station, an ecological research camp funded by National Science Foundation (NSF) and operated by the UAF Institute of Arctic Biology. The second phase of one or more houses will be completed at Anaktuvuk Pass, a remote Nunamiut Eskimo community in the central Brooks Range with a population of 302. This project will benefit many Northern communities by demonstrating the process of designing and building regionally appropriate, affordable, and simply constructed homes that uses very little water or energy.

Status:
The project is currently in the planning and design phase with a targeted date of the end of March for a design charrette in Anaktuvuk Pass. The project proposal is available on our website at: Research and Projects > Current Research Projects > Sustainable Northern Shelter Project
Built Environment Energy Efficiency Program

Description:
CCHRC developed a comprehensive energy efficiency program comprised of four interdependent subprograms: the Outreach and Awareness Program, the Energy Evaluation and Rating Program, the Training and Certification Program, and the Financial Resources for Energy Efficiency Program.

The subprograms work seamlessly to first make the consumer aware of the economic and environmental efficacy of creating a more energy efficient built environment, the steps that can be taken, and the resources available to complete the steps. The programs will encourage consumers to participate in a home energy evaluation and rating which will provide the homeowner with a list of recommendations to make their home more energy efficient. Additionally, the program will assist with providing information about suppliers and contractors able to deliver the products and services consumers choose to pursue. The program will also provide information on financial resources such as low interest loans and tax incentives.

Parallel to working with consumers, the program will offer energy audit, retrofit training, and certification services to contractors and other professionals involved in the built environment to ensure that the local professionals are able to perform the work necessary to meet consumer demand.

Status:
CCHRC is currently working with potential program participants to establish this program in the state.

Energy Extension Pilot Program for Rural Alaska

Description:
The University of Alaska Cooperative Extension Service (CES) and the Cold Climate Housing Research Center (CCHRC) will provide an Energy Extension Program for rural Alaskans to help them meet the rising costs of energy. The program will combine the applied research expertise of the CCHRC with the extension experience of the CES to provide the research, information, training, and education rural Alaskans need to make important decisions. The Energy Extension program will provide (1) assistance relating to the use, conservation, and development of energy resources, (2) a conduit for identifying which energy related needs would benefit most from university, state, and federal research, and (3) support for Rural Energy Extension at the campuses of the UAF College of Rural and Community Development.

Status:
Submitted to the University of Alaska President’s Fund. Pending.
Proposed Projects

Investigating Potential Applications of Environmentally Friendly Inorganic Cements to Cold Climate Construction

Description:
This project will investigate the applicability of Magnesium Phosphate Cements (MPCs) and geopolymers for resolving building problems common in different regions of Alaska and provide background information to private enterprises regarding potential in-state development opportunities. At a minimum, this project will result in the dissemination of information about how the use of magnesium phosphate cements and geopolymers could improve buildings in Alaska.

The best result would be for this project to lead to widespread adaptation of significantly advanced building technologies and the creation of a new sustainable industry within Alaska. Not only could these products be manufactured and used locally, but there is also strong potential for export to the global market. Practically, the results of this project’s success will be bringing Alaska closer to the global forefront of shifting human endeavors away from inefficient and unsustainable materials and practices (such as our dependence upon Portland cement) and toward more benign and beneficial solutions.

Status:
CCHRC is working with manufacturers to establish plans and relationships that will lead to product development and testing. A Snapshot introducing these materials has been written and is available on our website (www.cchrc.org) under Research and Projects > Reports > Snapshots > RS 2008-01, Substantially Superior Cements.
Applying New Materials and Technology to Alaskan Building Envelope Retrofitting

Description:
The purpose of this project is to test the applicability of and develop usage guidelines for specific, commercially available magnesium phosphate cement & geopolymer type materials for the purpose of residential building envelope retrofitting, especially using the Residential Exterior Membrane Outside-insulation Technique (REMOTE), in Alaskan climates.

There are clearly recognized needs for cost-effective and environmentally friendly renovation of existing residential structures throughout much of Alaska. This project will enable renovations to result in:

- Increasing the value and extending the useful life of existing housing stock without new construction
- Increasing structural longevity by decreasing their exposure to moisture
- Decreasing operational costs through improved energy and maintenance efficiency
- Decreasing occupant and community risks from fire and natural disasters through the use of strong, fire-inhibiting interior & exterior surface sheathing
- Providing healthier indoor environments less conducive to mold growth
- Decreasing the long term-cost of disposal and/or re-use of the structure when it is no longer viable by using environmentally benign materials.

Status:
We are working with manufacturers of these materials and products made from them to determine how they can be incorporated into other retrofitting projects being undertaken by CCHRC beginning in the summer of 2008.

Develop New Foundation Systems for Soils Underlain by Permafrost

Description:
We are working with researchers at the UAF Civil Engineering Department and at the US Cold Regions Engineering Laboratories (CRREL) to develop a National Science Foundation proposal to use the data being collected at the Research and Testing Facility to help design new foundation systems for soils underlain by permafrost.

Status:
We expect to submit this proposal in August.
Description:
This project will investigate the applicability of geopolymer cements made primarily from locally available coal ash for resolving building problems common to different regions of Alaska and provide background information to private enterprises regarding potential in-state product development opportunities.

Approximately 1.5 million tons of coal is extracted annually from the Usibelli mine in Healy, Alaska. Much of that coal is burned to produce electricity and heat. Ash and slag by-products are typically disposed of as waste.

Concrete made using Portland cement is the most common building material in the world. Portland cement is not environmentally benign. For each ton of Portland cement produced, approximately one ton of the greenhouse gas carbon dioxide is released into the atmosphere. Each ton of Portland cement produced also requires the BTU equivalent of over 400 pounds of coal. Replacing some of the Portland cement being consumed with some of the coal ash being produced and disposed of is one step toward economic efficiency.

Coal combustion products can be used instead of Portland cement as the primary component of a completely different type of cement with superior physical properties. This cement, an alkali activated aluminosilicate inorganic polymer, most commonly called a “geopolymer,” does not require expensive and wasteful manufacturing processes beyond that already incurred by burning the coal for heat and power.

CCHRC’s mission is predominantly focused on developing and promoting the practical application of scientifically sound innovations by private enterprise. Determining some of the potentials for developing solutions to serious housing and infrastructure problems prevalent throughout Alaska using these materials is an ideal task for CCHRC to undertake. The proof-of-concept application demonstrations CCHRC can provide will be a vital part of effective outreach efforts to private sector entrepreneurs.

Status:
The University of Alaska Fairbanks’ Institute of Northern Engineering (INE) has undertaken a pilot project working with these materials in CCHRC’s Research & Testing Facility. INE’s intention is to develop and submit a proposal to the National Science Foundation for in-depth material science research. CCHRC intends to be a collaborator in that proposal focusing on application development. We are also looking for private partners and funding for this project.
Contributors and Members

A special thanks to our members and those who contribute to the success of the CCHRC mission.

Research and Testing Facility Contributors

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Support CCHRC—Join us in Changing the World!
CCHRC members and sponsors provide vital sustaining support for our mission to promote and advance healthy, durable, and sustainable shelter for cold climates. In 2007, donations helped fuel our Hybrid Micro Energy Project (HMEP) and the Sustainable Northern Shelter forum. In the coming year, donations will help us develop new projects such as building demonstration homes in affordable green building for northern climates, expanding the scope of the HMEP project, and establishing an comprehensive education and outreach program.

From walls and roofs to electricity and heat, CCHRC’s mission to promote the cutting edge in northern shelter affects our everyday lives. Your donation to CCHRC makes change happen by providing valuable support to our efforts. Together we can build a more sustainable future.

If you are interested in becoming a member or donating to the CCHRC please contact the Cold Climate Housing Research Center at: (907) 457-3454. Or visit our website: http://www.cchrc.org/membership.html
For more information contact the Cold Climate Housing Research Center:

CCHRC, P.O. Box 82489, Fairbanks, AK 99708, Phone: (907) 457-3454, Fax: (907) 457-3456, www.cchrc.org