

Energy Efficiency Alternatives for Historic Buildings in Extreme Cold Weather Climates



Buckner Building. Whittier, Alaska. Photo by Gabor Eszes.

STEP 1

Identify Historic Features

1 Exterior aspects

2 Visual character at close range

3 Interior spaces

Murphy Hall, Ladd Field, Alaska. Photo by Cold Climate Housing Research Center

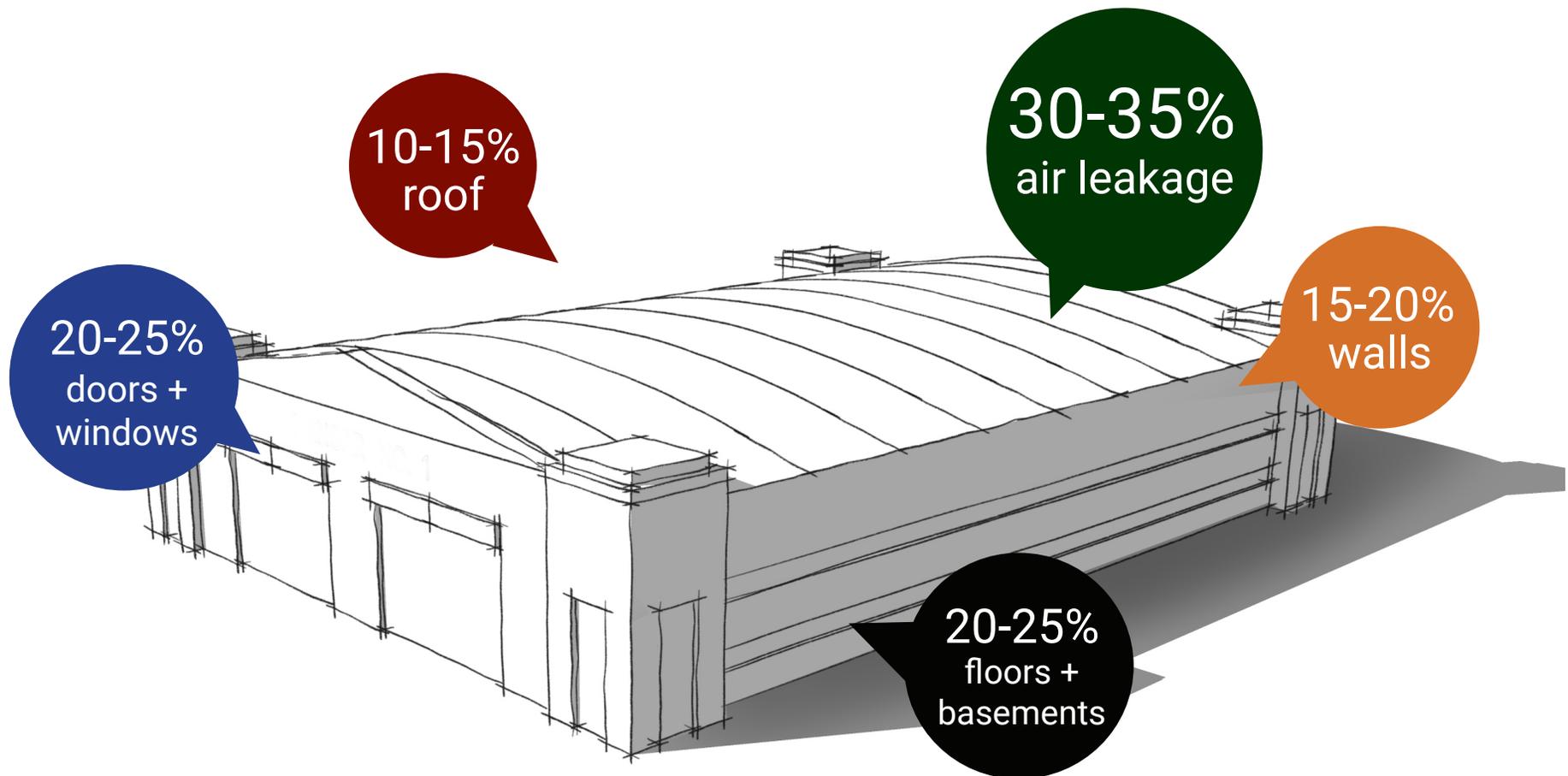


STEP 2

Determine Your Building's Energy Use

Before doing an energy retrofit, it is important to understand the energy flow in the building.

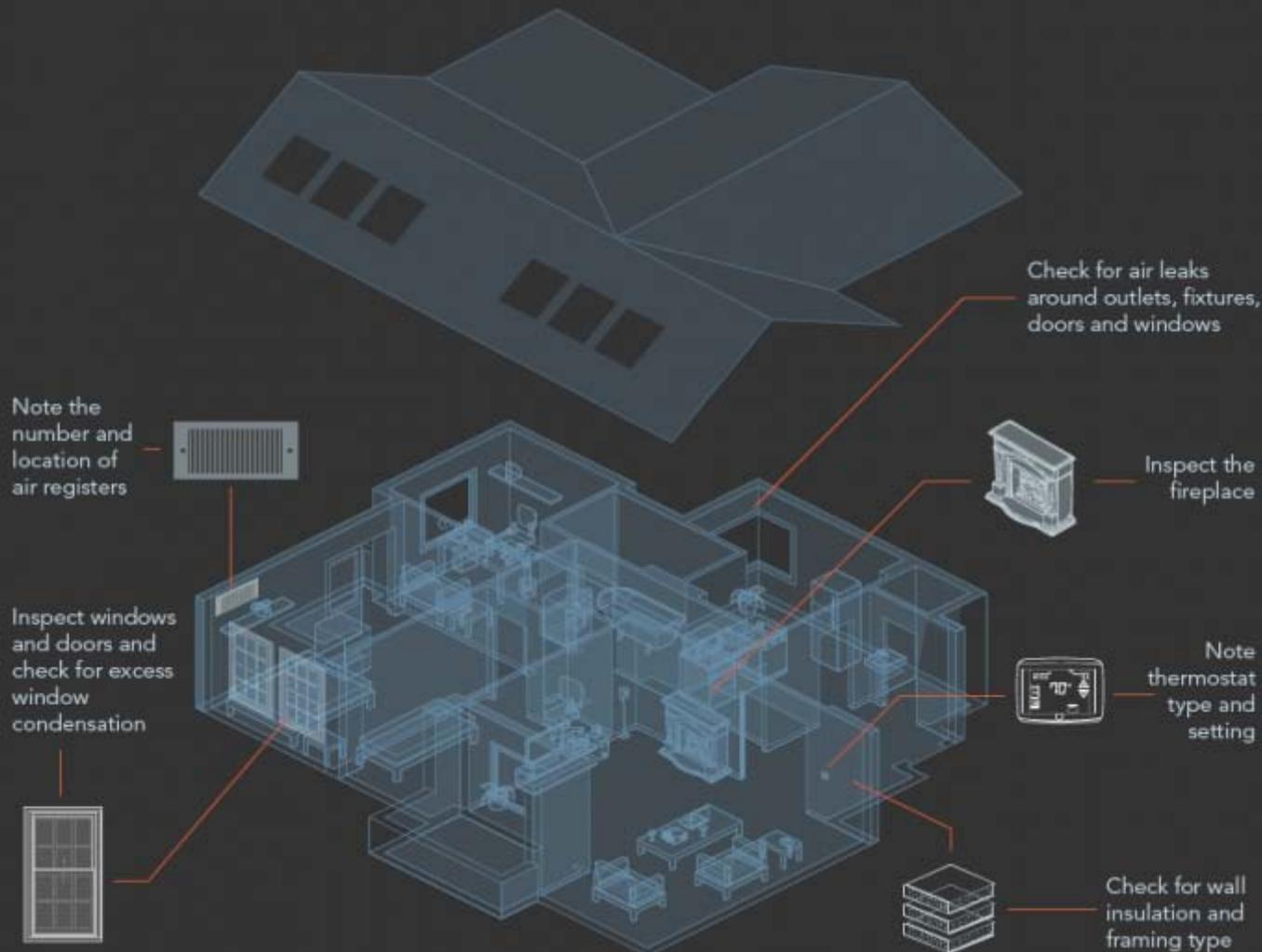
In cold climates, space heating generally makes up the biggest chunk of energy use. However, some buildings may be better served by reducing electrical or water use.



*Heat loss percentages are estimates from the Alaska Residential Building Manual, Seifert, ed. (2007) and not specific to any building.

Perform an Energy Audit

Any building in line for a retrofit should first have an energy audit. An energy audit is a systematic inspection of a building that evaluates the building's current energy use and potential energy saving options.



TESTS PERFORMED

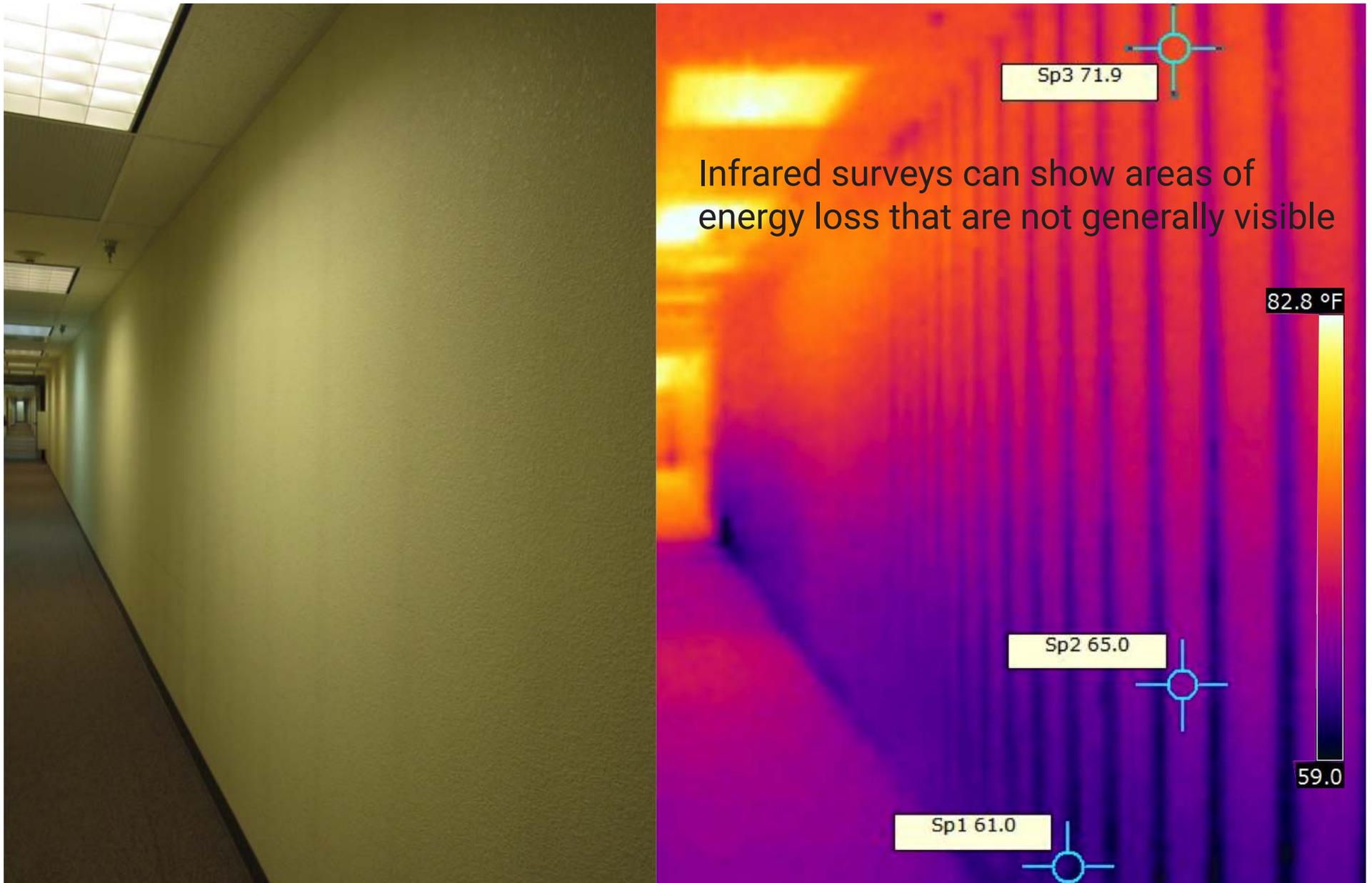
1. Blower door test
2. Infrared Imaging
3. Energy Modeling

INFO PROVIDED

1. Current energy evaluation
2. Air leakage
3. Cold spots
4. Appliance efficiency
5. Recommended improvements + cost-benefit estimates

Graphic by U.S. Department of Energy

Analyze Audit for Weaknesses in the Envelope



STEP 3

Perform a Cost-Benefit Analysis

Will the change pay for itself? It's important to perform a cost-benefit analysis of any recommended change to decide which retrofits to implement. An energy audit should tell you the estimated costs, expected savings and payback period of individual changes .

Installation cost divided by
estimated annual energy savings

IMPROVEMENT	INSTALLATION COST	ESTIMATED ANNUAL SAVINGS	PAYBACK PERIOD
Insulate outside walls	\$10,000	\$2,000	5 years
Insulate attic	\$5,000	\$1,500	3.3 years
Upgrade to triple-pane windows	\$15,000	\$1,000	15 years

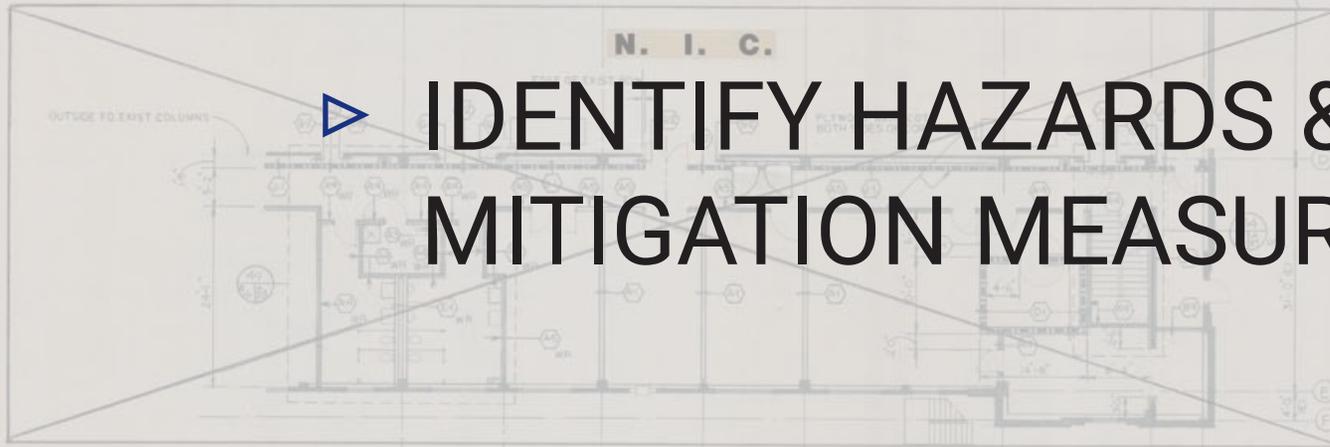
For resources on performing a cost-benefit analysis,
visit www.pnl.gov/feds

Design & Implementation

▶ DESIGN ENERGY EFFICIENCY STRATEGIES

▶ IDENTIFY HAZARDS & MITIGATION MEASURES

▶ CONSTRUCTION

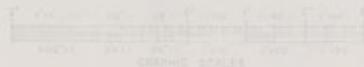


DIMENSION PLAN - LEVEL I EAST
PARTITION AND DIMENSION NOTES

1. ALL PARTITIONS, TYPE 'A' UNLESS OTHERWISE NOTED.
2. REFER TO PARTITION LEGEND THIS SHEET FOR PARTITION TYPES.
3. DIMENSIONS ON DETAILS TAKE PRECEDENCE OVER PLAN DIMENSIONS.
4. ALL PARTITIONS TO EXTEND FROM FINISHED FLOOR TO FINISHED CEILING OR FLOOR CONSTRUCTION ABOVE. SEE DEMOLITION PLANS FOR CEILING HEIGHTS, (EXCEPT DEMOUNTABLE PARTITIONS).
5. WALLS OCCURRING AT GRIDS 3 THRU 15 TERMINATE AT THE UNDERSIDE OF STEEL BEAMS, 10" HIGH AT LEVEL 1 AND 6" HIGH AT LEVEL 2. EXCEPT AT GRIDS 8 AND 10 WALLS EXTEND TO FINISH CEILING OR FLOOR CONSTRUCTION ABOVE.
6. ALL DIMENSIONS ARE FROM FACE OF FRAMING UNLESS OTHERWISE NOTED.
7. WR INDICATES WATER RESISTANT AWR

8. FIRE RATED WALL CONSTRUCTION DESIGNATED AS FOLLOWS:

2 HOUR WALLS [Symbol]
1 HOUR WALLS [Symbol]



PARTITION LEGEND

3/8" METAL STUDS @ 16" OC
5/8" TYPE X GWS EA SIDE
HORIZ BLOCKING @ 4' OC

6" METAL STUDS
5/8" TYPE X GWS
HORIZ BLOCKING

DOWN FULL HEIGHT
DOWN W/ 2" SOUND BATT INSULATION

DOWN DELETING GWS - HIDE
SAME AS 4-1 W/ 2ND LAYER GWS @ SIDE INDICATED BY ARROWHEAD

DOWN DELETING GWS - HIDE
SAME AS 4-2 W/ 2ND LAYER GWS @ SIDE INDICATED BY ARROWHEAD

DEMOUNTABLE PARTITION SYSTEM - TERMINATE AT BOTTOM OF SUSPENDED T-BAR CEILING

AS SHOWN FULL HEIGHT
AS SHOWN W/ 1/2" BATT INSUL. 1 V.B.
SAME AS #2 DRIPPING GWS @ ONE S.
SAME AS #2 W/ 2 LAYERS GWS @ ONE S.

N. I. C.

SOLID SHOUT
REINFORCING AS SHOWN

AS SHOWN

3/8" METAL STUDS @ 16" OC
2 LAYERS 5/8" TYPE X WATER RESISTANT GWS
WAINSCOT AS SCHEDULED (TYP)

1/2" SG WALLBOARD TES @ 48" OC

EXISTING CONSTRUCTION

NEW 3/8" METAL STUDS @ 16" OC
1/2" BATT INSULATION
VAPOR BARRIER
5/8" TYPE X GWS

EXISTING CONSTRUCTION

NEW 1/2" METAL STUDS @ 16" OC
5/8" TYPE X GWS

AS SHOWN
AS SHOWN W/O V.B. AND INSULATION
AS SHOWN REPLACING GWS WITH 1/2"

FULL HT. 3/8" METAL STUDS @ 16" OC W/ SOLID BLOCKING @ 4' OC VERTICAL
2 LAYERS 5/8" TYPE X GWS
5/8" TYPE X GWS

EXISTING FRAME WALL

NEW 5/8" TYPE X GWS DIRECTLY TO EXISTING WOOD FURRING AT 3" BETWEEN WINDOWS

AS SHOWN
AS SHOWN W/ V.B. BENEATH NEW 5/8" TYPE X GWS
REQUIRES REMOVAL OF WINDOW AND TOP TRIM AND INSTALLATION FURRING APPROX. 1/2" TO 1" W. WALL BETWEEN WINDOWS ALL FLUSH W/ SURROUNDING WALL

NOT USED
NOT USED
AS SHOWN
AS SHOWN REPLACING PLYWOOD WITH 5/8" TYPE X GWS AND ADDING 2" SOUND BATT INSULATION, WAINSCOT AS SCHEDULED

EXISTING FRAME WALL

NEW 5/8" TYPE X GWS DIRECTLY TO EXISTING WOOD FURRING AT 3" BETWEEN WINDOWS

AS SHOWN
AS SHOWN W/ V.B. BENEATH NEW 5/8" TYPE X GWS
REQUIRES REMOVAL OF WINDOW AND TOP TRIM AND INSTALLATION FURRING APPROX. 1/2" TO 1" W. WALL BETWEEN WINDOWS ALL FLUSH W/ SURROUNDING WALL

2 LAYERS 5/8" TYPE X GWS
WAINSCOT AS SCHEDULED VAPOR BARRIER

SHAFT WALL LINER AT HANGAR SIDE
1/2" METAL STUDS @ 16" OC
WAINSCOT AS SCHEDULED

5/8" TYPE X GWS AT ROOM SIDE
WAINSCOT AS SCHEDULED

SHAFT WALL LINER AT HANGAR SIDE
1/2" METAL STUDS @ 16" OC
WAINSCOT AS SCHEDULED

AS SHOWN
AS SHOWN
AS SHOWN
SAME AS 4-1 W/ 1/2" MDO PLYWOOD AT HANGAR SIDE
W/ VAPOR BARRIER

DAK770-99-0036
GASTON AND ASSOCIATES
ANCHORAGE ALASKA

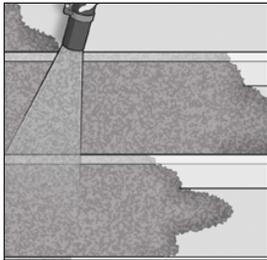
AS-BUILT

7

DIRECTOR OF ENGINEERING AND HOUSING

Match Energy Upgrades with Historic Features

SIMPLE STRATEGIES



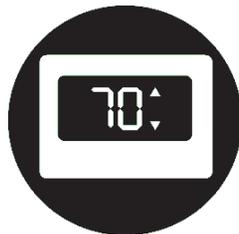
insulating
attic &
foundation



lighting

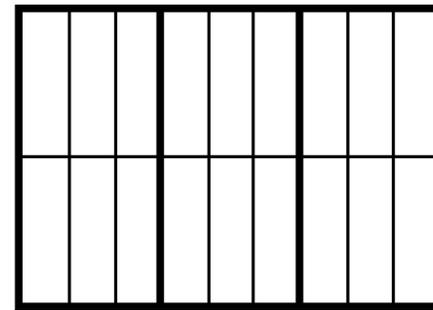


air sealing

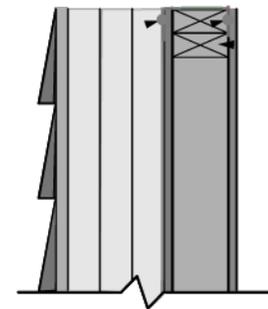


controls

QUESTIONABLE STRATEGIES



window replacement



exterior insulation

For guidance, contact the State Historic Preservation Office
at dnr.alaska.gov/parks/oha

Cold Climate Considerations

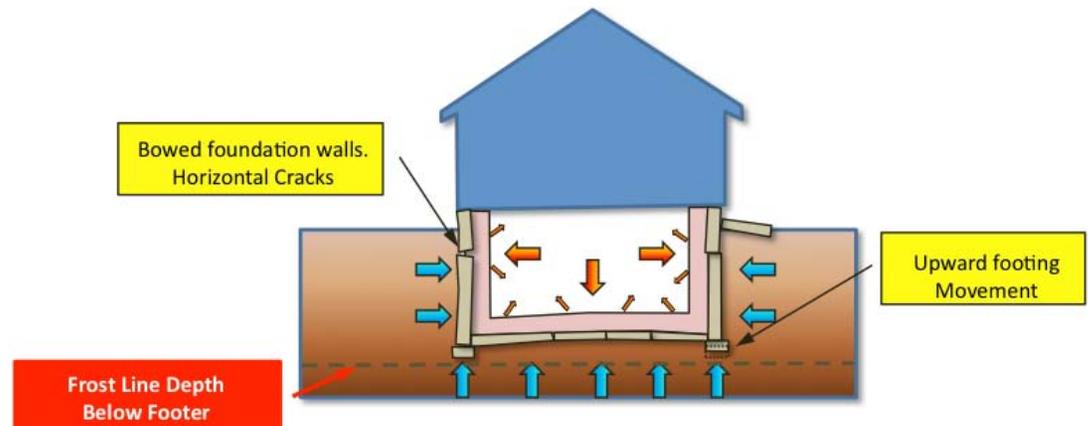
Any changes to the building envelope affect how the building performs as a system.



Sealing air leakage can create indoor air quality problems by allowing excess humidity and pollutants to build up. Air sealing must be coupled with ventilation to ensure healthy indoor air quality.

Adding insulation to the walls must follow building science best practices to avoid problems in the building envelope like condensation, mold, and rot (See image on the left.) These guidelines vary by climate.

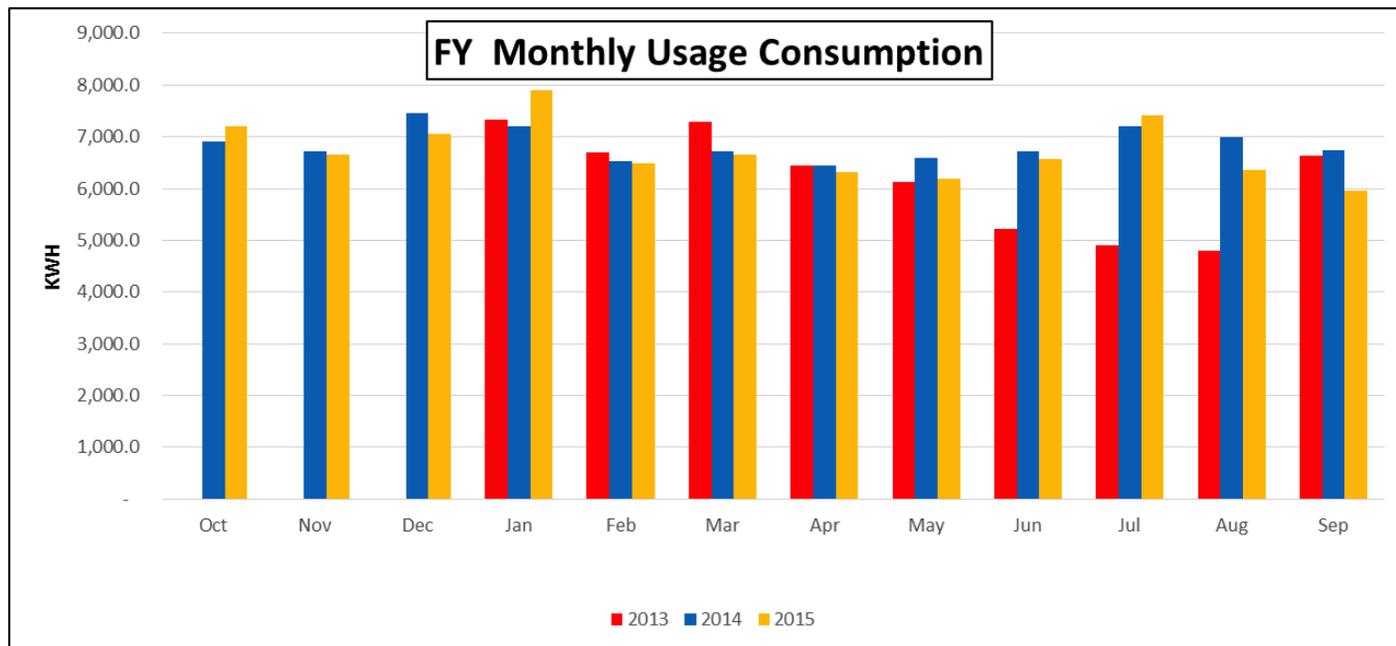
Insulating in and around the foundation requires knowledge of the surrounding soils and building science principles. Applying insulation without understanding the foundation system can lead to moisture concerns in the foundation walls, as well as frost heaving from the surrounding soils. (See below.)



Follow-up Monitoring

Make sure changes save energy and do not adversely affect the building

- ▷ Commissioning new building controls
e.g. thermostats, occupancy sensors
- ▷ Educate occupants on new systems
- ▷ Track energy use post-retrofit



Case Study: Ladd Field, Fairbanks, Alaska

Ladd Field National Historic Landmark (NHL) is located on Ft. Wainwright, Alaska. It was constructed in 1938 as part of the U.S. Army's defense build-up during World War II. During the war, Ladd Field was the headquarters for the Alaska-Siberia Lend-Lease route, which sent aircraft to the Soviet Union for use on the eastern front of the war.

Today there are 30 historic buildings that make up the NHL, laid out in a horseshoe formation around the runways. Hangar 1 is on the south end of the horseshoe, and a ring of barracks that are now being used as offices is on the north end.

The Cold Climate Housing Research Center made a site visit to Ladd Field to evaluate the energy efficiency of the buildings. The short site visit served to inform us about the building and allow for us to make suggestions to lower energy use. A formal energy audit is needed to come up with precise strategies and cost-benefit analysis.

The pictures on the right show the north side of Hangar 1. The infrared image shows heat loss through the building envelope. The yellow colors show the warmest parts of the building. As you can see in the regular picture, the brightest yellow spot is around the fire alarm. These photos suggest that when the alarm was installed, a hole was cut into the wall and was not air sealed. Warm air is leaking out of the hole and heating the outside of the building. This is just one example of the large amount of air leakage from the building (the ice on the roof is another result of air leakage through the ceiling).

Stopping air leakage from the building envelope is often the simplest and most cost-effective energy saving option. In the case of historic buildings, it has the added advantage of not altering the exterior look of the structure.

