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# ENERGY AUDIT REPORT – Moretown Fire Station


*This report was prepared under contract with the* ***Central Vermont Regional Planning Commission****, 29 Main Street, Suite 4, Montpelier, VT 05602.* ***CVRPC*** *can be contacted via email at cvrpc@cvregion.com , on their website at www.centralvtplanning.org, or by phone at 802/229-0389.*

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ENERGY AUDIT REPORT – Moretown Fire Station

Date: 07/19/10

Weather: 75°F, cloudy, light breeze

Executive Summary:

This energy audit was conducted with the goal of reducing the heating and electrical usage of the building. While the report details a number of findings, the key conclusions are as follows:

1. Foundation:
   Reduce heat loss by insulating the slab edge and exterior foundation wall to 1.5 feet below grade around the perimeter of the building. Save +/- 6% of heat costs.

2. Attic:
   Reduce heat loss to the attic by sealing gaps and penetrations in the unsealed walls that meet the attic plane and sealing gaps and penetrations in the unsealed attic plane. Provide a spray foam dam at the top of eave walls to prevent wind washing under the cellulose insulation while simultaneously sealing the top of the walls to prevent air leaks into the attic through the wall. Save +/- 4% of heat costs.

Building Features:

- Built in 2004, not listed on the National Register of Historic Places
- 3,528 square foot floor area
- Foundation:
  - Slab at grade on frost walls, no insulation visible on exterior perimeter, assumed foam board R-10 or better to insulate radiant in floor heat.
- Exterior Walls
  - 2x8 wood frame, fiberglass batt insulation, nominal R-24, estimated effective R-15 due to air migration in unsealed walls.
- Slanted Ceilings:
  - Scissor trusses 8/12 exterior 5/12 interior rising from +/- 19' walls to a 25' flat ceiling/attic plane.
  - 12" loose fill cellulose insulation, fiberglass batts used as blocking to prevent cellulose migration into soffits, nominal R-44, estimated effective R-30 due to air bypass heat loss through unsealed fiberglass batts at eave and gable walls.
- Attic:
  - Unsealed truss framed ceiling plane
  - +/-12" loose fill cellulose insulation, nominal R-44, estimated effective R-30 due to air bypass heat loss through unsealed fiberglass batts at gable walls.
- Windows:
  - Vinyl Framed double insulated glass. U-0.46 (R-2.17).

- Doors:
    - Steel insulated entry doors, U-0.17 (R-6).
    - Steel insulated garage doors, U-0.17 (R-6).

Heating System and Fuel Consumption:

Heating System:

- Buderus propane boiler.
- Radiant heat in slab on first floor. Radiant baseboard on second floor.
- 2 zones, one for radiant floor heating in slab and for baseboard radiators upstairs.
- Thermostat set at 60°, 68° when in use for meetings.
- 85% efficiency.
- CO 21 ppm which is an acceptable level.

Fuel Consumption:

- 2006-2007 heating season = 1015.6 gallons of LP gas = 93.3 million BTU
- 2007-2008 heating season = 1914.7 gallons of LP gas = 175.3 million BTU
- 2008-2009 heating season = 1379 gallons of LP gas = 126.3 million BTU
- Average = 131.6 million BTU
- This is equivalent to:
    - 37,293 BTU/square foot floor area

Data collected by Building Energy for buildings of similar use in Vermont indicates that the propane usage is below average:

| **Building** | **Square Foot Heated Area Of Building** | **BTUs Used Per Square Foot** |
|---|---|---|
| Woodbury Fire Station | 1,948 | 60,941 |
| Marshfield Fire Station | 2,546 | 43,630 |
| Moretown Fire Station | 3,528 | 37,293 |
| Average of Three Buildings | | 47,288 |

Hot Water: At the time of the audit, the necessary data was not available to calculate annual hot water consumption. The super store system for providing domestic hot water such as the one in use in the Moretown Fire Station, has proven to be adequate for the domestic hot water needs. It may be necessary to keep 35 gallons of hot water ready for use at all times in this fire station. However, if that is not the case, consider installing an LP gas on demand hot water heater that does not consume energy to keep a reservoir of water hot when it is not needed. Solar hot water systems are not recommended for buildings that do not have standard full time domestic hot water loads, such as showers, laundry, and dishwashers. Conservation will help to manage costs.

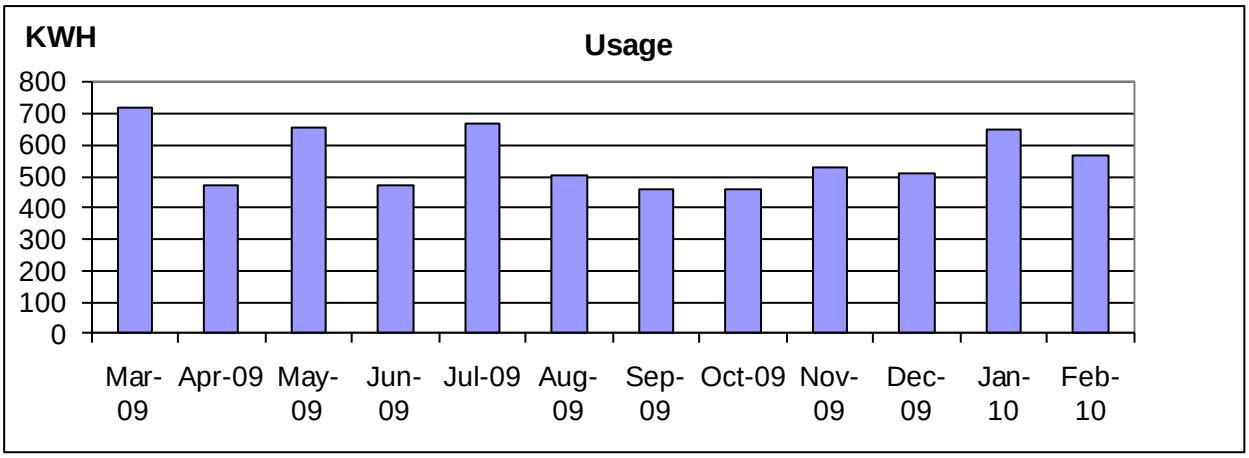
Inform occupants and visitors to conserve water by posting signs in the bathrooms and the kitchen.

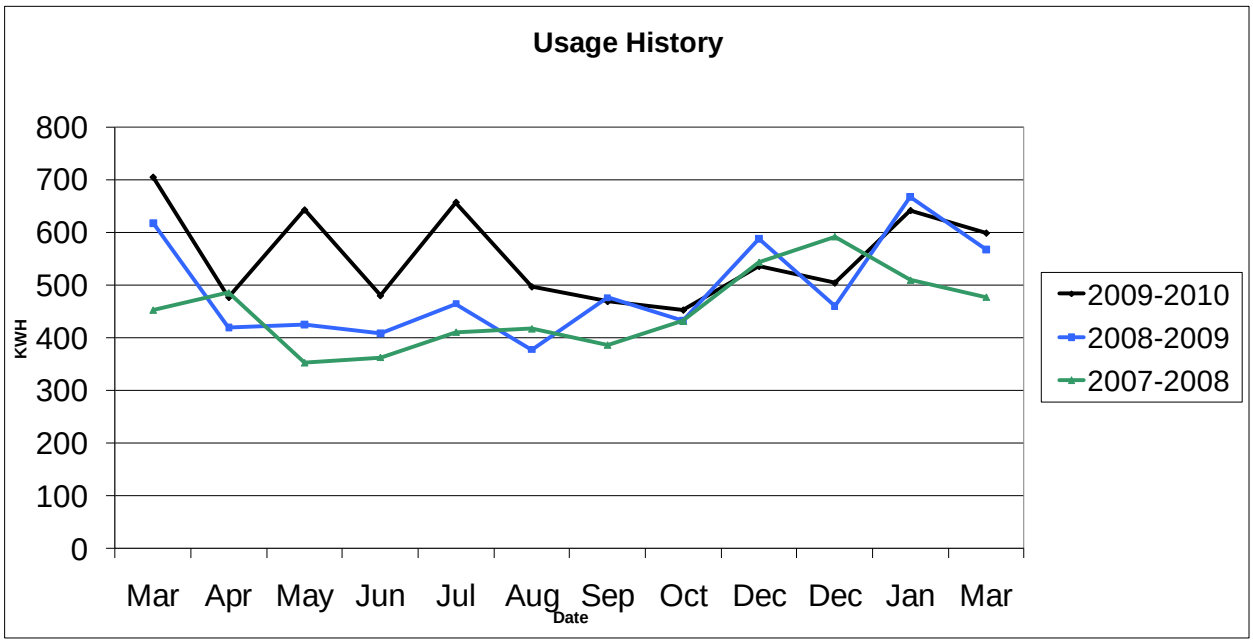
Electricity:

The Moretown Fire Station used 6,667 kWh of electricity over the past year. Data collected by Building Energy for buildings of similar use in Vermont indicates that the Moretown Fire Station electric usage is below average:

| **Building** | **Square Foot Heated Area Of Building** | **kWh Used Per Square Foot** |
|---|---|---|
| Northfield Fire Station | 9,700 | 1.11 |
| Woodbury Fire Station | 1,948 | 3.29 |
| Marshfield Fire Station | 2,546 | 2.42 |
| Moretown Fire Station | 3,528 | 1.89 |
| Average of Four Buildings | | 2.18 |

The specialty hose drying equipment and maintaining charge levels in emergency equipment coupled with unpredictable hours of use for this type of building may form a substantial portion of the usage. Higher usage in winter could be attributed to fewer daylight hours, constant need of heating circulation equipment, heating hot water to wash equipment, and a greater need to thaw and dry hoses. There was unusually high usage during the spring and summer of 2009. Refer to the charts below:






Lighting Efficiency Measures:

The lighting installed when the building was built in 2004 is up to current energy standards. One possible improvement would be to install occupancy sensors and work station switches to shut off energy use as a user moves from one area to another.

Efficiency VT is offering increased rebates for lighting upgrades before December 31, 2010 through a program called newLIGHT. This program includes installing occupancy sensors. The newLIGHT program is designed so the rebates offset the cost of the fixtures and installation labor to create a +/- 1 year payback. Electrical contractors that are registered with Efficiency Vermont can submit your project to determine eligibility. Contact Efficiency Vermont for a list of registered contractors or contact Cummings Electric (www.cummingselectric.com or 802-658-1292).
http://www.efficiencyvermont.com/stella/filelib/2010_newLIGHT_CustomerFactSheet_FINAL.pdf
http://www.efficiencyvermont.com/stella/filelib/newLIGHT_IncentiveSheet_FINAL.pdf

Other electrical savings measures:

- Turn compressed air equipment off when not in use. Check for system leaks to avoid unnecessary cycling of the compressor. Rebates are available from Efficiency VT when replacement is necessary.
  http://www.efficiencyvermont.com/pages/Business/RebateCenter/
- Turn computers off when not in use. Enable screen savers and hard drive sleep software to save energy when computers are not attended during the workday.
- Reduce or eliminate latent loads by installing advanced power strips on televisions, VCRs, DVD players, etc.
  http://www.efficiencyvermont.com/pages/Residential/SavingEnergy/home_electronics/Advanced_Power_Strip/

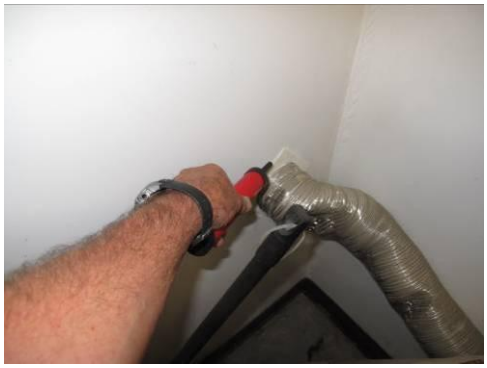
Blower Door and Air Leakage Testing:

The building tested 3,250 CFM50. This translates to 0.30 CFM50/shell square foot (entire surface area of building, including slab), indicating an above average level of air tightness.

| **Building** | **CFM50/shell square foot** |
|---|---|
| New "superinsulated" building | 0.10 or less |
| Typical older building | 1.00 |
| Northfield Fire Station | 0.45 |
| Woodbury Fire Station | 0.51 |
| Marshfield Fire Station | 0.29 |
| Moretown Fire Station | 0.30 |

Smoke testing was performed during building depressurization and clearly shows air leakage pathways. Air leaks and areas in need of thermal repairs are shown in the photographs below and listed in the Recommendations section.

The photos above show the use of fiberglass batts stuffed into the rafter cavity at the top of the exterior eave walls as a blockage to prevent the cellulose insulation from migrating into the soffits. However, this results in an air bypass around the cellulose insulation. The fiberglass insulation also does not prevent wind wash from pushing cold air between the cellulose insulation and sheetrock ceiling. A remedy is to remove the soffits and replace the fiberglass batts with a spray foam barrier that provides a seal to the top of the eave wall, stops wind washing, and provides superior thermal performance.



The four photos above show some of the ways that air can leak directly in or out of the building. Cold air will enter near the bottom of the building to make up for warm air that is escaping through leaks into the attic.

The two photos above show two obvious leaks through the attic plane. On the right, the under insulated attic hatch is also not weather stripped. On the left, the sheetrock edge disappears unsealed behind a beam. It is apparent that air moves through the resulting hidden gap.

Air moves through these outlets which have no direct connection to the outside. This demonstrates that air moves freely through the unsealed fiberglass, which allows cold air to enter and warm air to escape to the attic.

The gap shown at right is typical of the gaps found around the steel post and beam structure at the front of the building. When the drywall and vapor barriers were installed, there was no way to tape and seal the seams behind this structure. These gaps create an air leak passageway from floor to attic that should to be sealed.

Two out of three entry doors are badly out of adjustment. The photos on the left show the gap and the daylight that is visible on a fully closed and latched door located at the center of the building. The door to the right which is located near the front of the building is also out of adjustment. The doors need to be adjusted to fit the jambs and weather stripping evenly. Strike plates need to be adjusted so that the door is pulled into the weather stripping when closed and latched. In this case, at least one door may need to be taken out and completely re-installed.

The garage doors have adjustable rollers that can be used to pull the door tighter to the weather stripping or if needed the weather stripping can be installed to meet the doors. In this case it appears that the installation is adequate until there is wind pressure on the doors. With wind on the doors, there is a gap of ¼ inch or more. Weather stripping should be inspected annually and repaired or replaced as needed.

Even newer windows leak at meeting rails and jamb liners. Removable storm panels can be installed in the winter to seal the leaks.

The photo shows the uninsulated slab edge. Perhaps there is a thermal detail on the inside of the slab edge. If not, the uninsulated edge is a heat loss factor.

RECOMMENDATIONS:
The following list includes both short term and long term solutions to reducing utility costs and the carbon footprint of your building. We have put an asterisk next to the most pressing items. Please email us if you care to discuss priorities or have questions.

1. *Foundation insulation:
   The objective is to prevent the cold edge of the slab from robbing heat from the radiant heating system. There is no mention of a thermal barrier under or around the slab in the blue prints and specifications that were available for review. Common practice for insulation in radiant slabs would have visible foam board around the perimeter of the foundation as well as a foam board barrier beneath the slab. It may be possible that the slab was insulated from beneath with no provision for the cold edge. If this is the case, installation of foam around the perimeter of the building should be undertaken.
   - Dig a shallow ditch around the entire building, excluding the paved driveway, to access the foundation wall and slab for foam insulation.
   - Pressure wash the concrete for better adhesion of glue
   - Install 2" of foam board R-10 to 1.5' below grade.
   - Parge foam with fiberglass reinforced coating or flash to below grade.
   - Backfill ditch, rake, seed, and mulch.
   - Install formed flashing under siding to cover step in foundation profile and prevent moisture intrusion.

   Budget $50 per foot. Budget $8,500
   Save +/-6% of heating costs if the slab edge is currently un-insulated.

2. Eave Wall Sealing and Wind Wash Blocking: The object is to seal the top of the eave walls, provide superior insulating value in an area that is typically difficult to attain needed R-value with other types of insulation, and to prevent wind washing under the cellulose insulation.
   - Remove soffit and fiberglass batt blocking.
   - Clean away cellulose from the edge.
   - Spray a foam block to seal top of wall, insulate and provide a dam that prevents wind blocking and cellulose migration into the soffit.

   +/-100 square feet. Budget $45 per square foot. Budget $4,500.
   Save +/- 4% of heat costs.

3. Entry Door Adjustment:
   The object is to adjust the doors to meet the jambs and sill squarely. Close open gaps between door and weather stripping.
   - Remove 2 door assemblies and re-install.

- Adjust strike plate
- Replace weather stripping as needed

Budget $250 per door. Budget $500
Save +/- 1% of heat costs.

4. Garage Door Adjustment:
   The object is to adjust guide rollers to hold the doors tight against the weather stripping while allowing the doors to operate smoothly.
   - Adjust rollers.
   - Adjust or replace weather stripping as needed.

Budget $150 per door, Budget $450
Save +/- 2% of heat costs.

5. General Air Sealing:
   The object is to stop air leaks into the walls and attic plane.
   - Build and install an R-30 weather stripped attic hatch.
   - Seal gaps between structural steel beams and sheetrock with expanding foam sealant.
   - Caulk around window, door and corner trim with high quality urethane caulk.
   - Seal penetrations through walls and attic plane.
   - Seal the mud sill to the top of foundation wall on the exterior.

Budget $2,500
Save +/- 3% of heat costs.

Please email if you have any questions.
Thank you for hiring Building Energy.

Information and Resources:

1. www.epa.gov, www.energystar.gov
2. VT Agency of Natural Renewable Energy Project Grants, www.anr.state.vt.us
3. Vermont Energy & Climate Action Network, www.vecan.net
4. www.efficiencyvermont.com / www.veic.com
5. www.10percentchallenge.org
6. VT Clean Energy Development Fund:

   Anne Margolis
   Clean Energy Development Fund Manager
   VT Dep. of Public Service
   112 State Street
   Montpelier, VT 05620-2601
   (802) 828-4017
   anne.margolis@state.vt.us
7. Vermont Economic Development Authority, www.veda.org