New Hampshire Local Audit Exchange Program

Energy Audit Report
Philip Read Memorial Public Library

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BUILDING STRATEGIES FOR AN AFFORDABLE FUTURE
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A. EXECUTIVE SUMMARY

Program Introduction

Plainfield's Philip Read Memorial Library was one of 38 buildings selected to receive a Level II Energy Audit through the New Hampshire Local Audit Exchange (LAX) Program. The LAX Program was developed by the NH Office of Energy and Planning (NHOEP) as a means to provide no-cost energy audits to New Hampshire municipalities and school districts. Phase one of the LAX Program involves conducting comprehensive energy audits of municipal buildings across New Hampshire. Phase two will include analyzing the results of the audits and posting summarized information on the program website (nhlocalenergyaudits.com). The information will be grouped by building type which will allow other interested municipalities to browse the site for building types that match their own. This will allow those not directly involved in the program to identify similar recommendations and energy efficiency upgrade opportunities (as well as the associated costs and paybacks).

The objective of the audit is to identify energy conservation measures that reduce the net energy consumption thereby reducing operating costs and the consumption of non-renewable fossil fuel energies. In addition to energy conservation, the evaluations and recommendations presented herein consider occupant comfort and holistic building performance consistent with its intended use and function. The information obtained as part of this audit has been used to develop Energy Efficiency Measures (EEM's). These EEM's provide the basis for future building improvements and modifying the manner in which the building is operated.

This material is based upon work supported by the Department of Energy, American Recovery and Reinvestment Act of 2009 and the New Hampshire State Energy Program, under Award Number DE-EE0000228. This material was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of its employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

The LAX Program provides an ASHRAE Level 2 audit of selected municipal buildings and schools. The energy audits identify all appropriate energy efficiency measures for a facility, and a financial analysis based on implementation costs, operating costs, and attainable savings. The ultimate goal is to identify the amount to be saved, the amount the measure will cost, and the estimated payback period for each EEM. In addition, the audit discusses any changes to operations and maintenance procedures. Each municipal facility will have an in-depth field survey consisting of a site-visit that takes into consideration the following:

- Building Characteristics
- Building Use and Function
- Envelope Systems
- Heating and Cooling Systems
- Ventilation Systems
- Domestic Hot Water
- Lighting
- Other Electric Loads

Following completion of the field evaluation, the data and information are reviewed to develop proposed recommendations or Energy Efficiency Measures (EEMs) for the building(s). All information, data, and recommendations are then compiled into a comprehensive report. The final report is then distributed to the municipality to assist with implementation and budgeting of the proposed EEMs. The reports will then be shared on the public website where they can be accessed by other NH municipalities and schools. The information provided in the reports will assist these municipalities with determining the best value EEMs for their facilities. In addition to the facility information, the reports will identify potential financial resources available to help fund EEMs.

Summary of Findings in Plainfield's Library

Below is a summary table identifying the proposed recommendations, EEM costs, estimated annual energy cost savings, and simple payback period. Part E provides a more detailed explanation of these recommendations and divides them into Tiers based on initial costs.

- The walls in the 1920 building are not insulated.
- Neither the door, attic stairwell, nor top of the stairs are insulated or air sealed, leaving a significant hole in the thermal envelope for heat loss.
- The walls of the 2004 building have 1" continuous foam on the exterior, greatly diminishing thermal bridging through metal studs and making it a tighter building.
- The furnace heating the 1920 building is 42 years old and, while built to last, not built for energy efficiency.
- The 2004 basement has not yet been finished, but is heated. Considerable air leakage around the windows and a band of uninsulated above grade concrete, in contact with the metal studs are opportunities to improve performance for the life of the building at a fraction of the cost it would be to fix later.
- Programmable thermostats are installed and used well.
- Exterior storm windows on original 1920 windows are in good condition, as are the window sashes themselves. The 2004 windows have higher performing window glazing, but leak a lot of air around the sashes and rough openings.

Table 1 EEM Descriptions

EEM Description	Est Cost	Energy kWh	Saved Oil	Est. Annual $ Savings	Years Payback
Clear cabinet away from return and supply	$0	10	2	$9	0.0
Adjust nighttime setback to 60° 30 min before	$5	300	18	$124	0.0
Manage phantom loads	$60	130		$25	2
Mastic seal all ducts in old basement	$130	75	9	$48	3
Replace pendant 300 w with MaxLite 60 watt	$204	1872		$358	0.6
Replace (3) 75 watt halogens with 9 watt LED	$210	364		$69	3
Repair motorized damper for combustion air	$75		12	$45	1.7
Weather-strip doors	$125	75	19	$85	1
Replace 52 gallon water heater with 10 gallon	$400	1640		$313	1
Create thermal barrier at top of attic stairs	$500	200	75	$316	2
Replace T8 32W with T8 25watt	$787	972		$324	2
Spray foam from floor deck to 1' below grade	$850	60	52	$204	4
Spray 2-3" around exterior of attic furnace room	$960	50	30	$121	8
Air seal windows and doors	$1,325	195	47	$212	6
Air seal ceiling plane and add insulation	$3,600	215	60	$255	14
Replace Williamson furnace	$5,000	310	220	$875	5.7
Install thermapane storm	$5,600	350	120	$512	11
TOTALS	**$19,831**	**6818**	**664**	**$3,895**	**5**
REDUCTIONS		**34%**	**28%**	**33%**	

The EEM costs, estimated savings and resulting payback are based upon each independent measure implemented for the building in its current condition and function. Estimates are not warranted, or intended as exact predictions, but informed estimates for planning purposes only. There may be dependencies among measures that will affect the realized energy savings (parametric function). Estimated costs are provided for budgetary planning only. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures.

Other suggestions

- Explore contract with new supplier of electricity (as recommended in highway dept report).
- A dehumidifier is necessary in the 1920 basement, though has to be emptied to be effective. Pumping or draining the collected water directly to the outside is recommended.

B. HISTORIC UTILITY CONSUMPTION

Utility Data

Utility data for the Library was provided by Nancy Moglielnicki. Table 2 summarizes 12 months of the electric grid consumption and oil consumption in 2011. Electricity is supplied by PSNH. Table 3 breaks down the annual electrical use by month.

Table 2 – Annual Utility Use and Cost Summary 2011

Energy	Year Used	Units	Consumption	2012 Prices
Electric	2011	kWh	14,945	$ 2,756
Oil	2011	gallons	2,244	$ 8,325
TOTAL				**$ 11,071**

Based on the total energy consumption above, the total Btu's used is 362,213,822 Btu's or 362.2MMBtu's. Based on a total floor area of 8,014 ft2, the Energy Unit Intensity is 45.2KBtu per square foot. This is less than average for NH libraries.

Table 3 –2011 Electrical Utility Data by Month

Ending	Elec Use kWh	Electric Cost
13-Jan	713	$125.98
11-Feb	1,480	$263.28
14-Mar	1,370	$242.14
13-Apr	1,350	$270.42
13-May	1,160	$219.00
13-Jun	1,030	$191.56
13-Jul	1,000	$186.61
12-Aug	1,140	$204.52
13-Sep	1,220	$215.49
13-Oct	1,100	$223.45
14-Nov	1,240	$234.84
13-Dec	1,310	$276.24
31-Dec	832	$152.50
TOTAL	**14,945**	**$2,756**

The *average* annual electric usage over two years for the building was 15,374 kWh at a cost of $2,782. The monthly electrical usage for 2011 (Table 3) reveals a fairly consistent usage each month between with a slight increase in the winter months, due to furnace blowers and other heating related equipment. The average cost for electricity is .191 cents for kWh. Although the total annual electricity use is somewhat consistent with the expected use for the building size and function, there are potential measures that will reduce electrical energy consumption.

An estimation of energy consumption by end use (shown below in Table 4) is necessary in order to develop energy conservation measures with estimated energy reductions and dollar savings. These values were determined using observations from the field audit, interview responses from occupants, and typical energy consumption data for inventoried equipment and appliances.

Table 4 – Itemized Electrical Consumption

Equipment Type	ESTIMATED Consumption kWh/yr	ESTIMATED Total Consumption	ESTIMATED Annual Cost
Plug Loads	2,492	17%	$477
H20 Heating	2,800	19%	$536
Cooling	0	0%	$0
Lighting	8,477	57%	$1,621
Heating	1,176	8%	$225
TOTALS	**14,945**	**100%**	**$2,858**

Based on the estimation of energy by use category, the loads are relatively consistent for plug loads, lighting and mechanical loads for a building of this size and use. Lighting accounts for the largest share of the load (64%), though most lamps are T8 with electronic ballasts. Water heating has a more remarkable share considering the low hot water use which typically occurs in libraries.

Heating fuel is #2 heating oil and delivered by Simple Energy. The building used 2,244 gallons in 2011. At the time of this writing, the average market price in NH is $3.69, but the NHOEP projects an average of $3.71 for the 2012 season which is the dollar cost amount used for this report.

Table 5 – Oil Delivery for 2011

Month	Gallons	2012 $
January	618	$2,293
February	595	$2,207
March	456	$1,692
April	298	$1,106
May	83	$308
November	57	$211
December	137	$508
TOTALS	**2244**	**$8,325**

BUILDING INFORMATION & EXISTING CONDITIONS

Site

The Plainfield Library is located on a fairly level and open site at 1088 Rt. 12A, in Plainfield, NH. Plainfield is in Sullivan County and is considered in Climate Zone 5 by the EPA for determining insulation requirements in the International Energy Conservation Code. There has been an average of 8021 heating degree days (HDD) and 255 cooling degree days (CDD).

History and Current Use

The original 650 square foot building was built as the Philip Read Memorial Library in 1920 by Edmund S. Read, who then donated the building to the Town in honor of his father, Philip Read. In 2004, an over 6600 square feet addition was built, designed by Keene architect Tom Weller. While the main floor was completed and is visited by an average of 60 people every day it is open, the funds were not available to finish basement level until recently.

Occupancy Schedule

The Library is open to the public on the following days and times:
Monday: 1pm-9pm
Wednesday: 10am-9pm
Friday 1pm-5pm
Saturday 9am-Noon

In addition, meetings and activities may be held in the evening or weekends for an estimated total of 30 occupied hours each week.

Anecdotal Information

-The lights are turned on when the library opens and remain on till closing time.
-Thermostats are programmed to come up to 68ºF 30 minutes before opening and turn back down to 63º 30 minutes after closing.
-The dehumidifier in the original section of the building is manually emptied between every two weeks to two months.
-Architectural drawings, construction records, and operations manuals were readily available for review. This is not typical but considered best management practices and very helpful to this audit.

Building Envelope

The following sections present the building envelope systems and insulation values for the original building and the addition. For simplicity, they will be referred to as the "old" and the "new" buildings.

Foundation

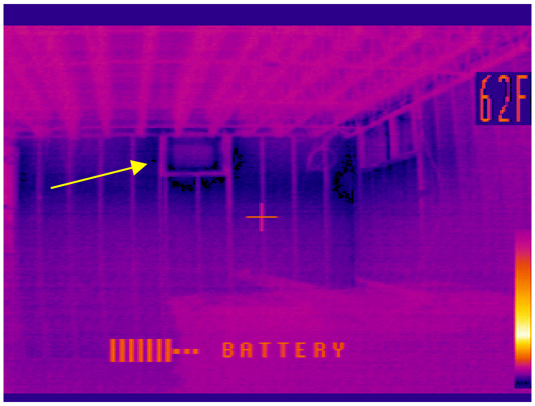
Both buildings were built on uninsulated slabs. The foundation wall in the old section is only visible in the furnace room which reveals a poured concrete foundation below grade supporting brick courses above. The photo below was scanned from an album of photographs of the 2003-2004 construction and suggests the brick is 16” deep. It also appears there may be an air space between the inner most courses and the outer layer. If this is the case, the air space prevents moisture wicking to the inside, which means the inner brick could be insulated without concern of trapping moisture and a freeze thaw cycle that can damage bricks. It is mentioned here in the event the interior of the foundation walls are ever exposed for any reason; it could be an excellent opportunity to insulate the interior of the foundation wall. The recommended thickness would depend on whether that air space exists or is an optical illusion.

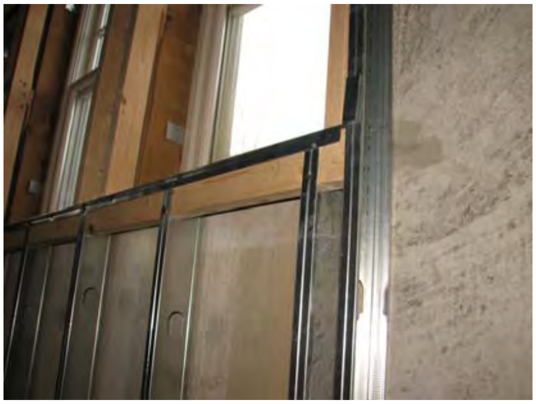
Photo from 2003

Archival book cases

As it is, most oft the 100 lineal feet of exterior foundation wall has been covered in wood panel and these glass case bookshelves which would add significant cost to move in order to insulate the walls. It is important to note that this appears to be working as archival, which would support the theory of an air space in the courses of brick and or the presence of some sort of moisture barrier between the earth and the interior environment. There is likely significant heat loss, especially through above grade brick, but without noticeable moisture problems occurring in the collections, insulation would not be cost effective at this time. It is discussed here because the fact that its working so well – and is such a creative use of space, including the day lighting, it indicates that the basement is kept warm enough to prevent condensation and/or the dehumidifier is effectively managing moisture loads. Changing either one of those things may increase the risk of moisture damage.

The unfinished new basement, however, does allow for cost effective improvements before further work happens. Photos from the construction album confirm the architect’s plans for the foundation wall: waterproofing, followed by insulation drain board applied on the exterior of the poured concrete wall. The insulation board used appears it may be a product called tough and dry with an insulation value of R10. Plans also called for metal studs directly on the interior concrete with 3.5” fiberglass batts in the cavities. The below grade R10 should be adequate to minimize thermal bridging through the metal studs. Above grade, however, the 1” XPS (R5) is less effective at warming the concrete enough to keeping the highly conductive metal from transferring cold. Of greater concern than even substantial heat loss is the plan for fiberglass batts in between cold studs in contact with concrete. and covered with a vapor barrier on the inside of paper backed drywall. This has proven to be a high risk assembly for condensation soaked batts, and often, mold, and highest of all in areas where there is no exterior insulation board at all, as evident in the IR images below.



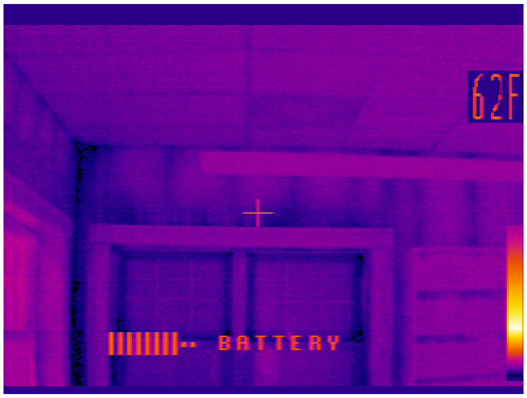


Outside grade is clearly visible here where exterior insulation, and earth, creates a warmer foundation wall. Above (darker), are colder surfaces; the coldest band where no exterior insulation exists. Condensation is possible, even likely, to occur in one or both of these cold bays, especially around window opening air leakage. Addressing this now will add costs to the construction but a fraction of what it will cost to fix after the fact. The other advantage of addressing it now will be seen in lower energy costs. This is a unique opportunity; which far too few structures built in the last ten to fifteen years have had. Please refer to Appendix A for more images.

Above Grade Wall Systems

The walls of the old building are 16" of brick with a plaster interior finish and no insulation. The resistance to heat transfer of fired clay brick depends on the density of the brick itself. The R value of these bricks could range from .12 to .33 per inch, or R1.92 to 5.28. (ASHRAE Fundamentals 1993, Chapter 20). Adding the resistance value of the plaster, exterior air films, and possibility of an interior air space, the old walls (excluding windows and doors) are estimated to have a total R value of R5. In terms of their relative impact of heat loss in the older building, walls represent approximately 33% of the energy used to run the Williamson furnace.

The newer walls have metal studs at 16" OC with 6" unfaced fiberglass batts in the cavities (photo right), an interior polyethylene vapor barrier (per drawings), with exterior sheathing wrapped in 1" XPS (photo next page). The 1" XPS foam reduces thermal bridging considerably; resulting in a whole wall thermal transmission value of R15.8. The performance of a metal 2x6 wall with 6" (R19) batts at 16"OC *without* continuous exterior foam is R10.1 due to the high thermal transfer at and near the studs. The R5 foam board actually adds an additional 5.7 to the whole wall.



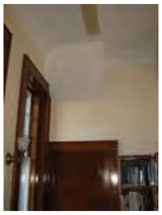
This is important to understand when deciding whether to add continuous insulation in the basement as well as around the concern about condensation occurring - especially in cold areas such as shown (darker areas) in the IR image to the right. Condensation occurs when vapor comes in contact with a surface at or below the dew point of the air temperature – such as a bathroom window or mirror during a hot shower. Imagine moisture in the air moving through a gap in the plastic vapor barrier – around an outlet for example – and moving towards the colder, drier air outside. When it gets to the sheathing, or the edges of a metal stud, the air will cool and if drops below the dew point, the vapor its carrying will change to liquid water. Too cold too dry to the outside, and the vapor barrier will prevent any drying back to the warmer interior. And that's the beginning of rot and mold. The risk may be mitigated in this case by an "air infiltration" barrier which was specified in the drawings to the inside of the rigid foam. If installed correctly, this would reduce the likelihood and amount of air transported vapor from entering the wall cavities in the first place. The 2012 code recommends R7.5 continuous insulation for Zone 6, though a minimum of R15 is recommended by building scientists so that the exterior sheathing (and everything to the inside) will always remain above the dew point. In other words, vapor may still get into the wall, but it will remain as vapor. It is also recommended to NOT put plastic or any vapor retarding material to the inside, so that any vapor that gets in – can dry back to the interior.

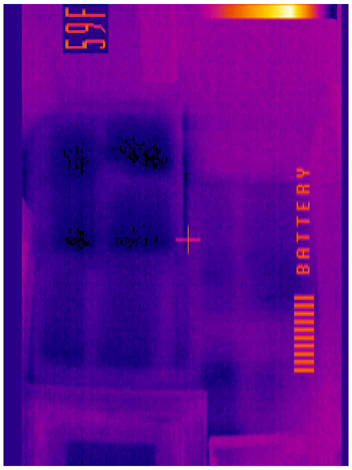
While this kind of information is not typically part of a Level II energy audit, this is an important aspect of this wall assessment: For both the heat loss from thermal bridging through metal studs and the possibility of condensation occurring on cold, enclosed, and plastic covered surfaces. And it is the background on the recommendations for the not yet finished basement walls.

Ceiling Systems

The thermal barrier is defined at the ceiling of the older building and above the suspended ceiling chase in the newer building. All roofs are cold, and at least partially 'vented' roofs.

The older ceiling is lathe and plaster on 2x6 wood joists, with 1" board decking on top of that, on about 80% of the attic floor area. There is a mixture of fiberglass and cellulose in the joist bays. The plaster forms a mostly effective air barrier, though there are unsealed penetrations for light fixtures and the chimney. The most significant deficiency, and opportunity, is at the attic stairs. The wood door is neither sealed nor insulated – nor is there an air or insulated barrier at the top of the stairs. Significant amount of warm air rises up this stair case, as well as heat conducting through the door and stairwell walls. The images to the right depict the coolth at and above the attic door and stairwell walls.





The newer building has a suspended ceiling which serves as a chase for wiring and duct work. Above that is a gypsum board ceiling secured to bottom rafters of roof trusses. The seams of the gypsum appear to be taped and spackled. This upper ceiling plane serves as a continuous air barrier which supports insulation above. There was no access hatch found to inspect the insulation or roof structure, but the plans specified R-38 fiberglass batt insulation.

Roofing Systems

The older building's roof framing consists of 2x8 rafters, tight fitting wood planks, and slate. The hip rafters shown in the photo are located directly above the attic stairwell. Note the moisture stains and little bit of rot. This does not appear serious, but is likely due to warm, relatively moist air rising up the stairwell in the winter and hitting the rafters where the vapor would condense. There appears that there may be a ridge vent of sorts under the cap, but no soffit venting and the one window is fixed pane and closed.

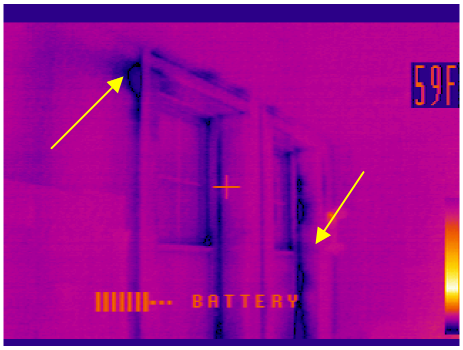
According the drawings, the roof over the 2004 addition is an engineered truss structure with 5/8" plywood sheathing, roof felt and asphalt shingles. Ice shield was specified in two 36" layers overlapping 6". Ventilation was specified to be via 'ventilation troughs' which is a superior strategy to the more typical propa vents.

Windows

The windows in the old building are the original wood double hung sashes with single pane, three over three on the top sash and lower sash one single panes. They operate via rope and pulley and are in excellent condition, though it was reported that they are rarely if ever opened. The trim is in beautifully restored condition. Good quality exterior storms were added, possibly in 2004. Such an assembly is typically estimated to perform at R1.9, though that does not factor in the substantial air leakage around the sashes, through the rope and pulley, and behind the trim through the rough opening.

There are 16 window units in the older section, for a total window glazing area of 164ft2 and a window to wall ratio of 16%; more than is typical in older buildings. It is estimated that they account for 5% of the whole building's conductive heat losses, but 17% of the heat loss in the older sections (excludes air leakage). The natural day lighting from these evenly dispersed windows is delightful. There is only one south facing window and those on the west are somewhat shaded by trees and the newer building, so summer solar gain should be minimal.

There are 55 wood, aluminum clad windows in the newer building with a total surface area of 511 square feet and a window to wall ratio of 17%, very close to the same proportions in the older building. The Eagle windows have ½ inch air space between two panes of glass low e and trademarked Maximizer Plus coating. The top sashes of double hung windows are the same three over three over one to match the older windows. Awning style windows exist in foundation walls near grade. IR scans suggest there is greater air leakage around these more recently installed windows, which is one of the concerns regarding vapor migration. The windows are made by Eagle and if meeting the specification of the plans, have a performance u-value of .33 or R3. New window glazing is responsible for approximately 10% of the building's conductive losses (excluding air leakage).



At -20 pascals, new windows have substantial air leakage around the sashes as well as through the rough window openings.

Doors

There are five exterior doors to the building. Both entrances facing Rt12 have enclosed vestibules which help buffer north blowing winds from entering the building. The original front doors are wood, while all other doors are insulated steel. All doors were found to leak air around their edges.

Air Infiltration

A blower door test was conducted using one Type 3 Energy Conservatory fan and a DG-700 pressure gauge. The purpose of the test is to measure the amount of air leakage through gaps and cracks in the thermal envelope. Putting the building under pressure can also be useful to locate air leaks and air leakage pathways.

Blower Door Assembly

The building was not able to be depressurized to the standardized -50 pascals with one fan, but did achieve -31pascals by pulling 5,963 cubic feet of air per minutes. From this result, it can be estimated that the building would pull 7,972 cubic feet of air to achieve -50 pascals (referred to as 7972CFM50). Based on an estimated total building volume of 81,720ft3, the air exchange rate at -50 pascals is 5.85 times per hour. This is a standardized measurement value for a relative assessment of the building's tightness in terms of outside air exchange within its volume. The lower the air exchange rate, typically the less energy wasted through air leakage, but also the less fresh air available, which, at some point, may become a concern which can be addressed through mechanical ventilation. The amount of fresh air exchange needed varies building to building. The trend is to make buildings tighter, carefully, and add mechanical ventilation as necessary because that typically requires less overall energy.

As a point of reference, standard home construction practices over the last 15 years have created homes which test between 7 and 9 air changes an hour at -50 pascals (7ACH50 to 9ACH50). Energy Star Homes must test under five air changes an hour under pressure (5ACH50), though as of 2012, that has been lowered to 3ACH50 and high performance homes tend to test under 1ACH50. At the other end of the spectrum, leaky old farmhouses can sometimes test at 15-20ACH50.

Under natural conditions, without a large fan depressurizing the building, these results suggest that the annual average is estimated to .31 times per hour. In winter conditions, the air exchange is estimated at over .55 times per hour. Said another way, due to air infiltration and exfiltration through gaps and cracks in the enclosure, just under half of the air volume inside the building would completely exchange with outside air every hour. This amount of air leakage accounts for approximately 39% of the heating fuel used every winter. But in other times of the year, without opening the windows, there may not be enough fresh air exchange for recommended CO2 levels to maintain good indoor air quality. In fact, CO2 levels were measured in the two different locations and both were within the recommended 1000ppm threshold. It should be noted that the site visit was conducted when the building was closed to the public and there were at the most three people. Daily number of visitors range from 20 to 90, with an average of 60. Nighttime meetings can have 30 or more people meeting in the older building. At these occupancies, it is highly likely that CO2 levels exceed the threshold 1000ppm and fresh air ventilation would be recommended. Therefore, conserving energy and maintaining good indoor air quality often require air sealing strategies as well as the potentially installing fresh air ventilation with heat recovery.

Building Summary

Spreadsheet calculations and algorithms were used to determine the building's peak heat loss. The heating system was assessed for combustion efficiency and standby losses, and it was estimated to account for between 22 % and 28% of the total Btu's from fossil fuel based fuels used for space heating. Heat losses through the various components of the thermal envelope accounted for up to

74% of Btu's from fuels. This analysis helps determine the impact, and cost effectiveness of making improvements to one or more envelope components.

Table 6 – Estimated Breakdown of heating oil usage in the Library

Estimated uses of 2244 gallons oil	Gallons	%
Envelope related heat losses	**1667**	**74%**
Uncontrolled Air Leakage	640	39%
Old Walls	172	12%
New Windows	167	10%
New walls	160	9%
Old Below Grade	128	7%
New Ceiling	109	6%
Old Ceiling	98	6%
Old Windows	86	5%
Slab	85	5%
Exterior Doors	22	1%
Furnace and distribution losses	**587**	**26%**
Internal Heat Gains	**-10**	
TOTALS	**2,244**	**100%**

Changes in thermostat settings and upgrades to any of the above components can have a direct impact on fuel usage. So can improving the effective performance of the envelope or the efficiency of the equipment and distribution system. However it is important to note the dynamics in thermodynamics and that buildings operate as whole systems, therefore predicting estimated savings depends on the totality of what is changed at any even given time.

The estimated peak heat loss for the whole building at a design temperature of -3°F is 120,000Btu/hr. Peak heat loss refers to the amount of heat that would be lost through the envelope (foundation, walls, ceilings, windows, doors, and air infiltration) during the coldest, or one of the coldest hour s o the winter. The design temperature is the temperature used for the peak heat loss calculation. The American Society of Heating, Refrigeration, and Air Conditioning, Engineers suggests using the coldest temperature for the area 96% of the time, which excludes most extreme lows usually only lasting a few hours. The importance of this 'peak heat load number' is that is how heating equipment is properly sized for optimal efficiency.

Thermal Imaging Survey

The thermal imaging survey was completed on the morning of the site visit. The survey was conducted using a black and white, high resolution (240x320) Monroe HR infra-red (IR) camera. Images were later colorized using Monroe software IR daq 32, but no other adjustments were made. The survey was conducted on the interior of the envelope as the influence of sun, wind, and moisture can offer misleading results on the exterior.

Thermographic equipment depicts anomalies in surface temperatures which can be used to identify heat transfer through building envelopes. The infra red camera only depicts surface temperatures, but it can provide helpful information when integrated with other information and details we know about the building itself. With proper interpretation, they can also be helpful in diagnosing potential moisture problems, electrical system overloading, heat loss through ducting and piping, high energy lighting fixtures, and energy intensive plug load equipment. They can also help tell the 'thermodynamic story' of a room.

After a thermographic scan from the inside of exterior surfaces, the following observations were noted:

- Windows and doors are a significant source of air infiltration and exfiltration. The newer windows leak substantially more air than the older windows.
- The fiberglass insulation in the frame walls appears to fill each cavity and held up under pressure, indicating the exterior air barrier is continuous.
- Steel framing is estimated to exceed 15% of the wall surface area with significantly lower thermal performance than insulated cavities. At the same time, the edges of the studs are crisp, indicating that thermal bridging has been significantly reduced thanks to the 1" continuous rigid foam on the exterior. Without that continuous layer, drywall surface temperatures have been found to be several degrees cold up to 2" on either side of the stud. (Thermal 'bridge' is an excellent term as heat will move from one side of material to the other as effectively as we uses bridges to cross rivers).
- The door and stairwell to the attic appears to be the single greatest deficiency (air and insulation gaps) in the thermal envelope.
- Heat gain by radiation through the entrance doors on the east and south is significant.

Electrical Systems

Supply & Distribution

Grid electricity is supplied by PSNH through a single meter located on the east side of the building. (Meter #28019914) The main service enters the building on an east corner of the original building.

Lighting Systems

Lighting fixtures in the building consist mainly of four foot, electronic ballasted, T-8 30 watts.

The lighting densities the stack rooms were measured and found to be within a consistent range of 49-52 fc (foot candles) in the center of the room and 26-29fc along the walls. A total of 43 four foot fixtures with serve the stack and reading rooms of the one occupied floor of the library. Originally, the fixtures each had three lamps in them, but the middle lamp has been removed in many of the fixtures to reduce light levels and save money. Light levels are consistent with the Illuminating Engineer Society of North America (IESNA) standards for prescribed use.

Table 7 Lighting Inventory and Consumption

Location	Fixture Description	# of Fixs.	W/Fix. (Def.)	Watts per circuit	Oper. Hrs (Def.)	Annual kWh	$Cost
Main Stack	F, (3) 4' T8, 32 watt elec ballast	15	64	960	1560	1498	$286
Children's	F, (3) 4' T8, 32 watt elec ballast	10	96	960	1560	1498	$286
East Stacks	F, (3) 4' T8, 32 watt elec ballast	10	64	640	1560	998	$191
Recessed	G24Q-3 4-pin base	13	26	338	1560	527	$101
Circulation	Pendant Lamps C571/C118	5	300	1500	1560	2340	$447
Offices	F, (4) 4' T8, 32 watt elec ballast	4	128	512	750	384	$73
Old Building	F, (1), 4' T12, 40 watt mag ballast	6	40	240	750	180	$34
Old Building	F, (3), 4' T12, 40 watt mag ballast	2	160	320	750	240	$46
Wall Sconces	twist CFL	9	13	117	750	88	$17
Janitor closet	F, (1), 4' T8, 32 watt elec ballast	2	64	128	250	32	$6
Basement	F, (2), 4' T12, 40 watt mag ballast	2	80	160	50	8	$2
South Entry	F, (3) 4' T8, 32 watt elec ballast	2	64	128	500	64	$12
	Incandescent	8	75	600	100	60	$11
	F, (2) 4' T8, 30 watt elec ballast	2	80	160	200	32	$6
Exit	LED	6	2	12	8760	105	$20
Outside Lights	halogen flood	3	75	225	1800	405	$77
Emergency	CC4 Type BV Cooper	5	18	90	200	18	$3
		144			**TOTALS**	**8,477**	**$1,619**

Plug Loads

Plug loads were determined based on equipment nameplate information and by real-time metering. The operating time for each item is based on observations, occupant loading and schedule, and typical operating time for the equipment.

Based on this analysis, the total annual plug load is 2,139 kWh from a wide range of specialized equipment and tools typical in a repair or mechanics shop.

Equipment is turned off at night, however some devices such as computers and monitors continue to draw small amounts of energy sometimes called trickle charges or 'phantom loads' which can add up to several hundred dollars a year in some cases. Plugging equipment into smart strips allow for depriving those phantom loads from accumulating, while also allowing necessary devices (phone answering machines, for example) to continue operating through the night.

Table 8 Other Plug Loads

Other Plug Loads						
Equipment Description	**Model**	**Manufacturer**	**Watts**	**Ann. Oper. Hrs.**	**Annual kWh**	**Costs**
Copier	NP7130		250	150	38	$7
Typewriter	XD6700	Smith Corona	75	100	8	$1
Laptop		Dell	65	1560	101	$19
Phone & charger	6.0 Plus	Panasonic	25	8760	219	$42
small fridge		Kenmore	350	700	245	$47
Microwave	Carousel	Sharp	300	300	90	$17
Fax	UX-510A	Sharp	100	200	20	$4
Typewriter		Smith Corona	75	50	4	$1
VHS player	VHS UV 413	Kinyo	200	60	12	$2
Desk top		Dell	125	1560	195	$37
Monitor		Dell	45	1560	70	$13
Printer	Deskjet 5740	HP	200	400	80	$15
low vision reader	20/20 Plus	Optelec	700	300	210	$40
Desk top		Dell	130	1560	203	$39
Monitor		Dell	45	1560	70	$13
Printer		Canon	200	400	80	$15
Desk top		Dell	125	1560	195	$37
Monitor		Dell	45	1560	70	$13
Printer	Deskjet 5740	HP	200	250	50	$10
Exhaust fan	Lavatory		110	750	83	$16
Elevator		ThyssenKrupp	250	200	450	$86
TOTALS					**2,492**	**$476**

Plumbing Systems

Water Supply

Water is provided by the Town's water supply. Water demand for the building serves a deep sink for janitorial services, and a lavatory.

Heating Systems

Domestic hot water (DHW) is supplied by one, electric, 53 gallon, Rheem water heater installed in 2004. The life expectancy of an electric water heater depends in part on the hardness of the water, but can range from 8 to 10-15 or even 20 years. It would not be surprising to have to replace the water heater within the next few years, less likely that it last another 10 years. Water temperature was measured at the lavatory sink at 118ºF. Wrapping the tank with insulation will reduce energy use, but ultimately, the tank is far larger than the occupants are using,

Space heating for the older building is provided primarily by a 1970 Williamson Temp-O-Matic furnace and forced hot air ducts supplying the floor of the library and two runs to the basement. One supply feeds a storage room outside the furnace room, with a return ducted to a register below. Both the supply and the return are blocked by a file cabinet. The nozzle has been downsized which has improved the efficiency of the 42 year furnace, yet it is likely still operating in the low to mid 70's. A good "old work horse", it was built even before the 1973 oil embargo; before energy efficiency was much of a consideration in heating equipment. While the basic premise of a forced hot air furnace is basically the same, newer technologies have improved the efficiency of nearly every component from the heat exchanger to the burner. Therefore, replacing this unit with a properly sized furnace is recommended over spending any more money keeping this one going.

The new building has a mechanical room in its attic and is accessed by a drop down stair by the elevator near the circulation desk. The stair is very difficult to bring down without gouging a half wall. While not impossible, it does make changing filters more of a chore and less likely to happen as frequently as it should. Access to servicing the equipment is also difficult. Combustion air is supplied by a duct from the gable end vent into the furnace room through a motorized damper. The damper is intended to be closed until one of the three furnaces calls for heat, however its either not working or never connected and is open all the time.

There are three furnaces and air handlers in the mechanical room, serving three zones in the newer building. One furnace serves the lower level and the other two the upper level. The mechanical room is sheetrock and the seams taped and spackled. There was no apparent access to the attic space beyond. Drawings called for this room to be fully insulated. IR scanning suggests that some batts may have fallen down, or otherwise compromised.

The AFUE's listed in Table 9 are the ratings by the manufacturer. Pierce Heating, who has been servicing the equipment has installed smaller nozzles on all four units and is getting combustion efficiencies between 83.5% and 84.75% on the Carrier and reports 78% on the Williamson. Combustion efficiency is one aspect of overall efficiency, so very low 70's is more realistic overall.

Assuming the estimated peak heat load calculation of 120KBtu/hr is correct, that is the size, or heating capacity, needed for the building 97% of the winter. The total output of all four furnaces exceeds The fact that the existing furnace has a 450Btu/hr capacity means that 1) it can get the building up to temperature very quickly and 2) it will rarely if ever operate at its own peak efficiency potential, instead short cycle: turn on and off again in a few minutes.

Table 9 Heating Equipment

Equipment Description	Model	Manufacturer	Nozzle	Input	Output	AFUE%
Basement Furnace	1164-12-8	Williamson	0.85	95,000	71,250	75.00%
Attic furnace 1	58CMA12011120	Carrier	0.75		99,000	80.5%
Attic furnace 2	58CMA12011120	Carrier	0.75		99,000	80%
Attic furnace 3	58CMA12011120	Carrier	0.75		99,000	80.5%
Cabinet Heaters (3)	900 Series - B	Manley	250cfm		10	

Air Handlers	EAT F°	LAT F°	min MBD	Motor	CFM	RPM
AHU-1	58	108	91	DD	1,620	MED H
AHU-2	66	100	60	DD	1,564	MED H
AHU-3	62	100	78	DD	1,370	MED H

Cooling

There is no mechanical cooling provided in the library. Windows are open when outside air can provide passive cooling.

Mechanical Equipment Energy Consumption

The electrical energy consumption for space and water heating was determined according to nameplate information and building function and occupancy schedules. The table below presents a summary of the mechanical equipment and estimated annual energy usage. Total mechanical consumption is estimated to be 7,040 kWh/year compared to 5,567 kWh/year for lighting and 4,461 kWh/year for plug loads.

Exhaust Ventilation Systems

Three Penn exhaust fans are installed in the library. The commissioning data is included in Appendix B. Actual indoor air exhausted by all three fans when operating is 350CFM.

Table 10 Heating Electrical Equipment and Use

Equipment Description	Model	Manufacturer	Watts	Annual Hrs	Annual kWh	Costs
Newer burners(3)	848S17D21088	Beckett	224	225	50	$10
AHU handlers (3)	58CMA12011120	Carrier	960	250	240	$46
Ignition	R8184G 1427	Honeywell	60	300	18	$3
Old burner	02-363	Williamson	250	225	62	$12
Blower fan	VQB48S17D2108B	Marathon Elec	220	300	66	$13
Electronic ignition	40200-02	Carlin	60	300	18	$3
Cabinet heater fans	CU935	Qmark	900	400	360	$69
oil pump			115	375	43	$8
Exhaust Fans	Zepherette	Penn	315	1000	315	$60
40 gal Elec hot water	81V40DD	Rheem	4500	541	2800	$535
TOTALS					**3976**	**$759**

Indoor Air Quality

Indoor air quality (IAQ) is typically based upon temperature (°F), relative humidity (%), and carbon dioxide (CO_2) measured in parts per million (ppm). This data provides the best representation of building ventilation performance and occupant comfort. They are also indicative of conditions that may be detrimental to building systems including moisture intrusion, mold and mildew formation, and fungi related damage of building materials. In the Plainfield highway department building, as with any building which has garage bays for trucks and other vehicles, the risks to indoor air quality are greater and more complex, but testing for all possible contaminants is beyond the scope of this audit.

Recommended temperatures vary based on the season, occupant activity, and relative humidity levels. Generally, recommended set point heating temperatures in northern New England range between 68°F and 72°F and recommended cooling set point temperatures range between 73°F and 76°F. In library, the thermostat settings are reported to be kept at 68°F when occupied.

Regardless of outdoor conditions or indoor activity, the recommended range for (most, non plant growing) indoor environments is between 30% and 50% relative humidity. While there are no known adverse health effects related to elevated CO_2 concentrations, it can cause acute illness including headaches, drowsiness, lethargy, and nausea. For this reason, the US Environmental Protection Agency (EPA) has established a recommended threshold concentration of 1,000 ppm.

The IAQ was measured during the site visit in the afternoon in the main stack room and the older building. The stack room was 68.5°F, 41%RH and 780ppmCO2. The older building was 66.4°, 39.8%RH, and 725ppmCO2.

C. EPA PORTFOLIO MANAGER BENCHMARKING

The EPAs ENERGY STAR© Portfolio Manager for Commercial Buildings is updated to reflect current utility data. This benchmarking program accounts for building characteristics, regional climatic data, and user function. It then ranks a building within its defined category amongst all other buildings entered in the program to date. The defining metric is the building Energy Use Intensity (EUI). If a building scores at or above the 75th percentile in its category then it becomes eligible for ENERGY STAR© certification pending an on-site validation review by a licensed Professional Engineer. Currently the program does not have categories for every commercial building type but they can still be entered into the program and checked against similar buildings to determine where the building ranks compared to the current national average. The average energy intensity for every building type category is constantly changing and theoretically is it reducing as more efficient buildings are constructed and existing buildings implement energy conservation measures. Therefore, buildings that currently meet the eligibility requirements may not be eligible next year when they apply for annual re-certification.

Table 11– Annual Energy Consumption

Energy	Site Usage MMBtu
Electric - Grid	50.9
Oil	311.2
Total Energy:	**362.2**

Table 12 – SEP Benchmarking Summary

Location	Site EUI (kBtu/ft^2/yr)	Source EUI (kBtu/ft^2/yr)
Plainfield Library	45	60
National Average	70	127
% Difference:		**-52%**
Portfolio Manager Score:		**N/A**

Compared to the building category facilities that have entered data Portfolio Manager to date, the Philip Read Memorial Library uses 52% energy than the national average. With a source EUI of 60kBtu/ft^2/yr, it has a lower EUI than the current National average of 127kBtu'ft2 . This means that the building utilizes less than half source energy than similar facilities nationwide. It should be noted that this is a nationwide average and does not indicate how it compares to other New Hampshire or New England buildings.

The EPA's Portfolio Manager is a very good piece of software to take a "snapshot" of one's annual energy use and presents the analysis in a simple, comprehensive, and intuitive way. Unfortunately, there are still limitations with Portfolio Manager and shortcomings occasionally occur. In this case and multiple-use buildings in general, Portfolio Manager is unable to generate a benchmark score because libraries are categorized as the space type "Other," which triggers the following error message:

> Floor Area for "Other" Space Type(s) Is Greater than 10% of Total Floor Space. Currently, Portfolio Manager cannot compute an energy performance rating for properties where more than 10% of gross square footage is comprised of a space type that is designated as "Other" - nor can such properties apply for an ENERGY STAR label.

However, site and source energy usage scores are good alternatives in determining energy based comparisons to similar types of buildings.

D. RECOMMENDATIONS

Energy Conservation Measures

Based on the observations and measurements of the Plainfield Library building, several energy conservation measures (EEMs) are proposed for consideration. These recommendations are grouped into three tiers based on the cost and effort required to implement the EEM. EEMs are ranked within each tier based on the cost for implementation.

Tier I EEMs are measures that can be quickly implemented with little effort for no or little cost. They include routine maintenance items that can often be completed by facility maintenance personnel and changes to occupant behavior or building operation. Tier II items generally require contracted tradesmen to complete but can generally be implemented at low cost and within operating building maintenance budgets. EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures.

Simple payback is calculated for the proposed EEMs. The cost to implement the measure is estimated based on current industry labor and equipment costs and the annual cost savings represents the reduced costs for energy savings. The net energy and cost savings for smaller EEMs is based on the estimated reduction of the associated energy consumption as defined in the model and equipment inventory. Using these costs, the payback period is then calculated as the number of years at which the cost of implementation equals the accumulated energy cost savings. Other qualitative considerations that do not influence the Simple Payback Method calculation but should be considered by the owner during the decision-making process include:

- Occupant comfort
- Relative operation and maintenance requirements
- Remaining useful life of equipment and systems to be replaced
- Building durability
- Indoor air quality

Energy cost savings are based on the current net electric utility charge of **$0.191** per kWh (PSNH). Heating oil cost of **$3.71** per gallon is based on NHOEP's predicted average cost for a gallon of oil for the 2011-2012 heating season.

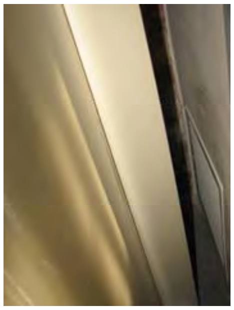
Tier I Energy Efficiency Measures

Tier I EEMs are measures that can be quickly implemented with little effort for no or little cost. They include routine maintenance items that can often be completed by facility maintenance personnel and changes to occupant behavior or building operation. Six (6) EEMs are recommended based on the observations made during the site review.

Table 13 Tier One EEM

EEM Description TIER ONE	Est Cost	Energy kWh	Saved Oil	Est Yrly $ Savings	Years Payback
Clear cabinet away from return and supply	$0	10	2	$9	0.0
Adjust nighttime setback to 60° 30 min before	$5	300	18	$124	0.0
Manage phantom loads	$60	130		$25	2
Mastic seal all ducts in old basement	$130	75	9	$48	3
Replace pendant 300 w with MaxLite 60 watt	$204	1872		$358	0.6
Replace (3) 75 watt halogens with 9 watt LED	$210	364		$69	3
Totals	**$609**	**2752**	**29**	**$633**	1

Further descriptions:



Forced hot air systems work best when the system is balanced, ie when the same amount of warm supply air returns to the furnace to be re-heated. Keeping all ducted registers clean and free of obstacles helps this happen. A file cabinet is blocking a return register (photo) on the other side of the furnace wall; relocating the cabinet will allow for better air flow and balanced circulation.

Setting deeper nighttime setbacks will save energy and money. Try setting back to 60 degrees and adjust the time a little if necessary. Experiment again after envelope recommendations are implemented as they will decrease the amount of time needed to bring the building back up to temperature.

It seems that library staff is diligent about turning equipment off at night, but many devices still 'trickle' draw energy when turned off. Power strips allow shutting off power entirely to anything plugged in to them. New "smart" strips have dedicated outlets which stay powered while disconnecting others, which can be helpful for computers which need to be updated overnight, though monitors and printers can be shut off entirely.

There is evidence of proper taping of some ducts in the older furnace room, yet many seams are not sealed. Applying two thin coats of mastic to all accessible duct seams is a cost effective way to improve distribution. Be sure to seal all return ducts especially to decrease the risk of depressurizing the furnace room inadvertently.

The five pendant light fixtures over the circulation desk were evidently chosen with great care. Evidently, the lamps have not been replaced since 2004, and literature suggests they are 300 watt lamps. MaxLite 60 watt CFLS are intended to replace 300 watt incandescent lamps at considerable savings. New 9 watt led lamps can also replace the 75 watt halogen spots.

Tier II Energy Efficiency Measures

Tier II items generally require contracted tradesmen to complete but can generally be implemented at relatively low cost and sometimes within operating building maintenance budgets.

Table 14 Tier Two EEM

EEM Description **TIER TWO**	**Est** **Cost**	**Energy** **kWh**	**Saved** **Oil**	**Est yrly $** **Savings**	**Years** **Payback**
Repair motorized damper for combustion air	$75		12	$45	1.7
Weather-strip doors	$125	75	19	$85	1
Replace 52 gallon water heater with 10 gal	$400	1640		$313	1
Construct insulated and sealed attic access	$500	200	75	$316	2
Replace T8 32W with T8 25watt	$787	972		$324	2
Spray foam from floor to 1' below grade	$850	60	52	$204	4
Totals	**$2,737**	**2947**	**158**	**$1,287**	**2**

Further descriptions:

Combustion air for the attic furnace room is supplied through a duct and motorized damper which appears not to be working properly and allows cold air in at all times.

Infra red scanning indicates air leakage around the exterior doors. Professional gasket installation is recommended.

While the water heater likely has years of service left, it is believed to be larger than necessary for the libraries hot water needs. Replacing it with a much smaller storage tank will save energy keeping more stored hot water than needed.

The attic stairwell acts as large hole, or chimney, in the thermal envelope for warm air to rise and heat to conduct to cold. Create a operable, insulated and gasket sealed, door in the floor plane of the attic for easy access, but to bridge that hole. The door should have at least 4” of rigid foam and be weighted enough to form a seal.

Replace all at T8 32 Watt with super T8 25 watt lamps. PSNH rebates are not included in the estimated costs but should be applied for.

The goal of this EEM is to apply a minimum of 3” of closed cell spray foam against the concrete foundation wall and rim joists in the basement, to at least one foot below grade to overlap with exterior insulation, and in a continuous application. This will require moving the existing metal framing. Cutting or moving, whichever is more cost effective, but it is important to apply the foam behind the metal studs.

Tier III Energy Efficiency Measures

EEMs that require large capital expenditure and budgetary planning (one year or greater) are categorized as Tier III measures.

Table 15 Tier Three EEM

EEM Description	**Est**	**Energy**	**Saved**	**Estimated**	**Years**
TIER THREE	**Cost**	**kWh**	**Oil**	**$ Savings**	**Payback**
Spray 2-3" on exterior of attic furnace room	$960	50	30	$121	8
Air seal windows and doors	$1,325	195	47	$212	6
Air seal ceiling plane and add insulation	$3,600	215	60	$255	14
Replace Williamson furnace	$5,000	310	220	$875	5.7
Install thermapane storm	$5,600	350	120	$512	11
Totals	**$16,485**	**1120**	**477**	**$1,975**	**8**

Capital costs are provided for budgetary planning only. They are estimated based on current industry pricing. A detailed cost estimate should be developed prior to appropriating capital funds for the more costly measures.

Fiberglass insulation was specified to be installed on the exterior of the attic furnace room to bring the heating equipment "into the thermal envelope". IR imagings indicate a number of insulation voids, perhaps from batts which have fallen. To make a more effective thermal barrier, temporarily move fiberglass away and spray 2 to 3" closed foam against the back of the gypsum board and over studs on walls and ceiling; then position the batts back and hold in place with netting.

Use IR images in the appendix as a guide to effectively air seal windows and window openings.

After conducting a thorough heat load calculation which includes all envelope improvements and blower door test, replace the furnace for the 1920 building with a good quality, properly sized, warm air furnace with sealed combustion. Good quality furnaces have better heat exchangers and other components and features and are worth investment.

The original 1920 windows are in good condition and of historic value. The most cost effective way to substantially reduce heat loss is to install custom made interior thermapane storms which are very tightly installed. They may be removed for the summer, or left in place if the windows are never opened.

Indoor Air Quality Measures

The following are measures recommended for improving air quality and other safety concerns but may not yield energy savings:

The operation of the three exhaust fans are not clear as they appear to be intended primarily for the basement which has not yet been finished. With additional air sealing, introducing fresh outdoor air may be advised, and therefore installing a heat recovery (HRV) unit in the basement would be recommended.

Suggested Money Saving Measures

1. Research other sources of electricity suppliers. PSNH would still be the primary utility but some towns have been able to negotiate electricity costs down one or two cents per kWh which could save $300-$400 per year. A list of possible options can be found in Appendix C.

Operations and Management and other Recommendations

1. Design way for dehumidifier to pump or drain directly to the outside and away from the building or install condensate pump.
2. Consider adopting an equipment policy which evaluates efficiency of donations and purchases before accepting. An Energy Star Only policy may make it easier. Also consider the energy related expertise of donated materials, labor, or services.
3. Check furnace filters every three months and replace as needed to improve efficiency of air flow and air quality.

Renewable Energy Considerations

While renewable energy systems generally require a higher capital investment, they provide a significant reduction in the consumption of non-renewable fossil fuel energies. Other obvious benefits include a reduction in ozone depleting gas emissions (as measured by CO_2 equivalency), otherwise referred to as the "carbon footprint". Renewable energy systems also reduce the reliance upon fossil fuels derived from foreign nations and mitigate pricing fluctuations in a volatile and unpredictable market.

Evaluating the practicality of a renewable energy system for a specific facility should consider several facility specific variables including:

- Geographical location.
- Building orientation.
- Adjacent and abutting land features.
- Site footprint and open space.
- Building systems configuration and condition.

- Local zoning or permitting restrictions.
- Currently available financial resources (grants, utility provider rebates/incentives, tax incentives).

Table 19 provides a summary description of the more common and proven renewable energy technologies. The Table also provides a preliminary feasibility assessment for implementing each technology at the Plainfield Library. A more rigorous engineering evaluation should be completed if the Town is considering implementing any renewable energy system.

Table 16 – Renewable Energy Considerations

Renewable Energy System	**System Description & Site Feasibility**
Solar Photovoltaic Systems	***System Description:*** Photovoltaic (PV) systems are composed of solar energy collector panels that are electrically connected to DC/AC inverter(s). Collector arrays can be rooftop or ground-mounted. The inverter(s) then distributes the AC current to the building electrical distribution system. Surplus energy is sent into the utility grid via net metering and reimbursed by the utility at a discounted rate. The capital investment cost for PV systems is high but the technology is becoming increasingly more efficient thereby lowering initial costs.
	Site Feasibility: The building orientation suits for a PV system on the roof, though the dormer on the south slope interrupts ideal conditions. Following recommended conservation measures, a small-size PV system (<5 kW) could supplement approximately half of the annual use. This would require a design and permitting process with the local utility. Current utility incentives and renewable energy grants could help offset the capital cost for the system. It should be noted that the utility would still be supplying electricity from the grid so the monthly fees for transmission would still be charged. Energy generated from the roof top array would essentially be bought back by the utility supplier at the same rate the Town is charged, thereby offsetting 50% of the monthly bill.
Solar Domestic Hot Water	***System Description:*** Solar domestic hot water (DHW) systems include a solar energy collector system which transfers the thermal energy to domestic water thereby heating the water. These are typically used in conjunction with an existing conventional DHW system as a supplemental water heating source. Because of the high capital cost, solar DHW systems are only feasible for facilities that have a relatively high demand for DHW.
	Site Feasibility: Based on the relatively low demand for domestic hot water, a solar hot-water system is likely not a practical consideration for the building.

Geothermal Heating & Cooling	***System Description:*** Geothermal heating systems utilize solar energy residing in the upper crust of the earth. Cooling is provided by transferring heat from the building to the ground. There are a variety of heating/cooling transfer systems but the most common consists of a deep well and piping loop network. All systems include a compressor and pumps which require electrical energy. Geothermal systems are a proven and accepted technology in the New England region. Site constraints and building HVAC characteristics define the practicality.
	Site Feasibility: A geothermal heating and cooling system is not likely a practical consideration for the building at this time. While the parcel provides adequate area for well installation and spacing, the low cooling load and relatively small heating load does not warrant the capital investment involved and the three carrier furnaces are still relatively new.
Wind Turbine Generator	***System Description:*** Wind turbine generators (WTGs) simply convert wind energy into electrical energy via a turbine unit. WTGs may be pole mounted or rooftop mounted however system efficiency improves with increased elevation. Due to cost and site related constraints, WTG technology in New England is only practical for select sites. Constraints include local geographical and manmade features that alter wind direction, turbulence, or velocity. Other technology constraints include local variability of wind patterns and velocity. Additionally, WTGs require permitting and local zoning that may restrict systems due to height limitations, and/or, visual detraction of the local landscape. Presently, WTG technology is not widely used in New England based on the relatively high capital cost compared to the energy savings.
	Site Feasibility: It is not likely that wind is a viable renewable resource for this location, at least with present turbine technologies. There are many constraints that determine if WTG is prudent for a particular site including: • Local zoning restrictions. • Detraction of the local landscape and abutter opinion. • Permitting requirements. • Local wind characteristics. Determining the local wind characteristics would require a wind study of the site.
Combined Heat & Power (CHP)	***System Description:*** Combined heat and power (CHP) systems are reliant on non-renewable energies. Systems are composed of a fossil-fuel powered combustion engine and electrical generator. Electrical current is distributed to the building distribution system to reduce reliance on grid supplied electricity. Byproduct thermal energy derived from the combustion engine is recovered and used to heat the building (this is generally considered to be renewable energy). Another benefit of CHP systems is that they provide electrical energy during power outages in buildings that do not have emergency power backup. Larger CHP units require a substantially large fuel supply and if natural gas is not available then a large LPG tank must be sited.

	Site Feasibility: Because there is no hydronic heating system in place, CHP system is not a practical technology at this time.
Biomass Heating Systems	***System Description:*** Biomass heating systems include wood chip fueled furnaces and wood pellet fueled furnaces. For several reasons, wood chip systems are generally practical only in large scale applications. Wood pellet systems can be practical in any size. Wood chip systems are maintenance intensive based on the market availability and procurement of woodchip feedstock and variability of woodchip characteristics (specie, size, moisture content, bark content, Btu value) which affect the operating efficiency of the furnace and heating output. They require a constant feed via a hopper and conveyor system and feed rates must vary according to feedstock Btu value and heating demand. For these reasons they typically require full-time maintenance and are practical only in large scale applications. Wood pellet systems are much less maintenance intensive and feedstock availability and consistency is less of an issue. Both systems reduce the dependency on fossil-fuels and feedstock can be harvested locally.
	Site Feasibility: A pellet boiler is likely not a practical option since there is no hydronic system in place, though replacement of the furnace is advised, replacing it with another FHA furnace would be considerably less expensive It is always worth consideration however because the cost per Btu is considerable less than fossil fuel or electric options.

Existing Measures

Existing measures includes EEMs and initiatives that were observed during the evaluation. They identify the facilities commitment to reducing energy consumption, enhancing occupant comfort, and improving overall building performance.

1. Efficient lighting fixtures and lamps were installed in 2004.
2. Smaller furnace nozzles have been installed.
3. Thermostat settings are lower than typical (68/62).
4. Water temperatures already set at or below 120º
5. The newer 2004 building has several features which are considered good practices but often get slashed as projects begin to go over budget. Congratulations are in order, in particular, for installing a seam sealed gypsum ceiling above the suspended tiles, which no one will ever see. This air barrier has likely saved 200 to 300 gallons a year for a roughly estimated total of $5-6,000 since it was built.

E. ENERGY EFFICIENCY INCENTIVES AND FUNDING OPPORTUNITIES

The State of New Hampshire along with the utility companies offer multiple programs designed to improve the energy efficiency of municipal and school buildings through financial incentives and technical support. Some of the currently available programs are presented herein however building managers are encouraged to explore all funding and incentive opportunities as some programs end and new programs are developed.

New Hampshire Public Utilities Commission's Renewable Energy Rebates

The Sustainable Energy Division provides an incentive program for solar electric (photovoltaic or PV) arrays and solar thermal systems for domestic hot water, space and process heat, with a capacity of 100 kW or equivalent thermal output or less. The rebate for PV systems as follows: $1.00 per Watt, capped at 25% of the costs of the system or $50,000, whichever is less. For solar hot water (SHW) systems, the base rebate is $0.07 per rated or modeled kBtu/year, capped at 25% of the cost of the facility or $50,000, whichever is less, as a one-time incentive payment. For more information, visit http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html, or contact Kate Epsen at (603) 271-6018 or kate.epsen@puh.nh.gov.

Public Service of New Hampshire (PSNH) (*STATEWIDE*)

Small Business Energy Solutions

The Small Business Energy Solutions program, or "Retrofit" program, is designed for business customers with an average monthly demand of less than 200 kilowatts (kW) and operating aging and inefficient equipment. The energy efficient technologies that are available to replace your current equipment as part of this program include:

- Energy efficient fluorescent ballasts, lamps and fixtures
- Hard-wired and screw-in compact fluorescent systems
- High intensity discharge lighting systems
- Occupancy sensors
- Programmable thermostats
- Refrigeration controls, motors, and economizers.

PSNH offers two options for utilizing the rebates through this program:

1. *PSNH provides a vendor/contractor. This option includes:*
    - Payment up to a maximum of 50% of labor and material costs for installation of identified energy-efficient measures.
    - A lighting or refrigeration analysis at no cost. This analysis identifies opportunities for enhancing the energy efficiency of your business.
    - A qualified energy contractor who provides you with a written proposal outlining the recommended energy-efficient improvements. This proposal will include a detailed explanation of each energy-efficient improvement identified, a review of projected energy and cost savings, and the estimated return on your investment. The contractor will also walk you through the retrofitting process and answer any technical questions you may have.

   - A review by PSNH to ensure that the proposed project is cost-effective and appropriate for your facility.
   - Installation of identified upgrades.
   - A post-installation inspection by PSNH to verify that the equipment was installed and is working, and that the job was done to your satisfaction.

2. *Your preferred contractor performs the installation, which includes:*
   - Prescriptive installations provide you with set rebates per fixture. PSNH performs before and after inspections and reviews equipment proposals to help you maximize energy savings.
   - Custom rebates cover a percentage of your costs for energy efficiency upgrades. To qualify for rebates, custom projects must pass a benefit/cost test. For retrofit projects, the rebates cover either 35% of the installed cost, or the amount required to achieve a 1-year payback (whichever is less).

For more information on this program, visit http://www.psnh.com/SaveEnergyMoney/For-Business/Small-Business-Energy-Solutions.aspx, or call 800-662-7764.

Municipal SmartSTART Program

The Municipal SmartSTART (Savings Through Affordable Retrofit Technologies) advantage is simple – pay nothing out of pocket to have energy efficiency products and services installed in your building. The Smart Start program is limited to PSNH's municipal customers only and includes schools. The program is available on a first-come, first served basis to projects which have been pre-qualified by PSNH. The cost of the improvements is fronted by PSNH which is then repaid over time by the municipality or school using the savings generated by the products themselves. This program is for lighting and lighting controls, air sealing, insulation and other verifiable energy savings measures which have sufficient kilowatt-hour savings. For more information on this program visit: http://www.psnh.com/SaveEnergyMoney/For-Business/Municipal-Smart-Start-Program.aspx, or contact Catalina Celentano, PSNH's Seacost Program Representative at celencj@nu.com.

F. PROCEDURES & METHODOLOGY

Standards and Protocol

The American Society for Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has developed the most widely accepted process for completing energy audits at commercial facilities. ASHRAE document RP-669, SP-56, *Procedures for Commercial Building Energy Audits* defines several levels of audits. The appropriate level of audit for a particular facility depends on the availability of existing data and information, owner objectives, and owner budget. Levels range from simple benchmarking to a comprehensive review of all building systems. The most common audit is a Level II which is typically conducted as an initial audit to identify EEMs and establish budgetary costs for implementation. Level II audits are commonly referred to as "Investment Grade Audits".

Basic elements of a Level II Investment Grade Audit include the following:

- A review of existing facility data including energy usage.
- Benchmarking the facilities energy usage relative to similar use facilities.
- An on-site inspection and survey of all building systems.
- On-site measurements and data collection.
- Informal owner and occupant interviews.
- Energy use analysis and development of conservation measures.
- Developing a simple payback cost estimate for each recommended measure.
- Development of a comprehensive report that clearly presents all findings and provides recommended energy conservation measures and the associated costs.

In addition to the ASHRAE standard for commercial audits, there are industry and code-based standards that must be considered when analyzing building systems and evaluating energy conservation measures. All recommendations must be consistent with the intent of these standards. For example, the US Environmental Protection Agency (EPA) has established a recommended carbon dioxide (CO_2) threshold concentration of 1,000 parts per million (ppm) to promote a healthy indoor air environment. ASHRAE defines recommended temperatures, relative humidity levels, minimum ventilation rates, and energy standards. The Illuminating Engineering Society of North America (IESNA) prescribes recommended lighting densities based on the designated space use. The International Code Council (ICC) is the adopted standard for all building and energy codes (2009) in the state of New Hampshire. New Hampshire has also adopted ASHRAE Standards 62.1 and 90.1.

Table 17 – Relevant Industry References, Codes and Standards

Standard	Description
28 CFR Part 36	ADA Standards for Accessible Design
ANSI/ASHRAE Standard 55	Thermal Environmental Conditions for Occupancy
AHSRAE Fundamentals 1993	Chapter 22 – Thermal and Vapor Transmission Data
ANSI/ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ANSI/ASHRAE/IESNA Standard 90.1	Energy Standards for Buildings Except Low-Rise Residential Buildings
ICC 2009	International Building Code (IBC)
ICC 2009	International Existing Building Code (IEBC)
ICC 2009	International Energy Conservation Code (IECC)
IESNA Lighting Handbook	Reference and Application
NFPA 70	National Electrical Code (NEC)

While the primary objective of an energy audit is identify energy conservation measures, such measures cannot adversely affect occupant comfort and indoor air quality. For example, if a building ventilation system is inadequate then it would be recommended that additional ventilation capacity be added. The electrical power required to operate the added ventilation equipment would increase energy consumption. Typically, the net energy usage incorporating the sum of the recommended conservation measures would still be less than the current usage even with the added ventilation equipment.

It is noted that although there is a prescriptive approach to commercial building audits, that every building is unique in many ways. Buildings should be evaluated consistent with the characteristics that define its need and appropriate function. This includes the following.

- Building system characteristics, and more importantly, how each system integrates within the composite facility ultimately determining building function and energy usage.
- Current building use and occupant needs.
- The manner in which the operator controls the building systems.

Benchmarking

Facility benchmarking is completed to analyze overall building performance relative to other buildings with similar use and operating characteristics. The most widely accepted benchmarking program is the ENERGY STAR® program developed by the US Environmental Protection Agency (EPA). The *ENERGY STAR® for Commercial Buildings* program ranks buildings based on how much energy they use as compared to buildings located throughout the United States. There are several categories for buildings as determined by use and function. If a building ranks at or above the 75th relative percentile, then it is eligible to receive the ENERGY STAR® certification.

Site Visit and Data Collection

Margaret Dillon of S.E.E.D.S., the Auditor assigned to Plainfield's Philip Read Memorial Library audit, conducted a comprehensive site visit and building inspection of the building on November 22nd, 2011 and followed standard protocol for a Level II audit, described below.

All building systems that impact energy consumption are evaluated including the building envelope, heating and cooling, ventilation, electrical, plumbing, and mechanical. The evaluation also considers whole building performance that measures how well the integrated building systems function as a composite system.

In addition to collecting equipment information, several data measurements are obtained as part of the facility site review. This data is necessary to identify potential building issues and to collect the information needed to develop an accurate energy analysis. Measurements include:

- Infra-red thermal imaging survey of the building envelope.
- Blower door testing to quantify and qualify air infiltration rates and impacts.
- Indoor air quality (IAQ) measurements (temperature, relative humidity, and CO_2).
- Lighting metering to determine energy use and operating schedules.
- Lighting output density.
- Metering of energy intensive plug-loads to determine energy use and operating schedules.

Data Gap Review and Analysis

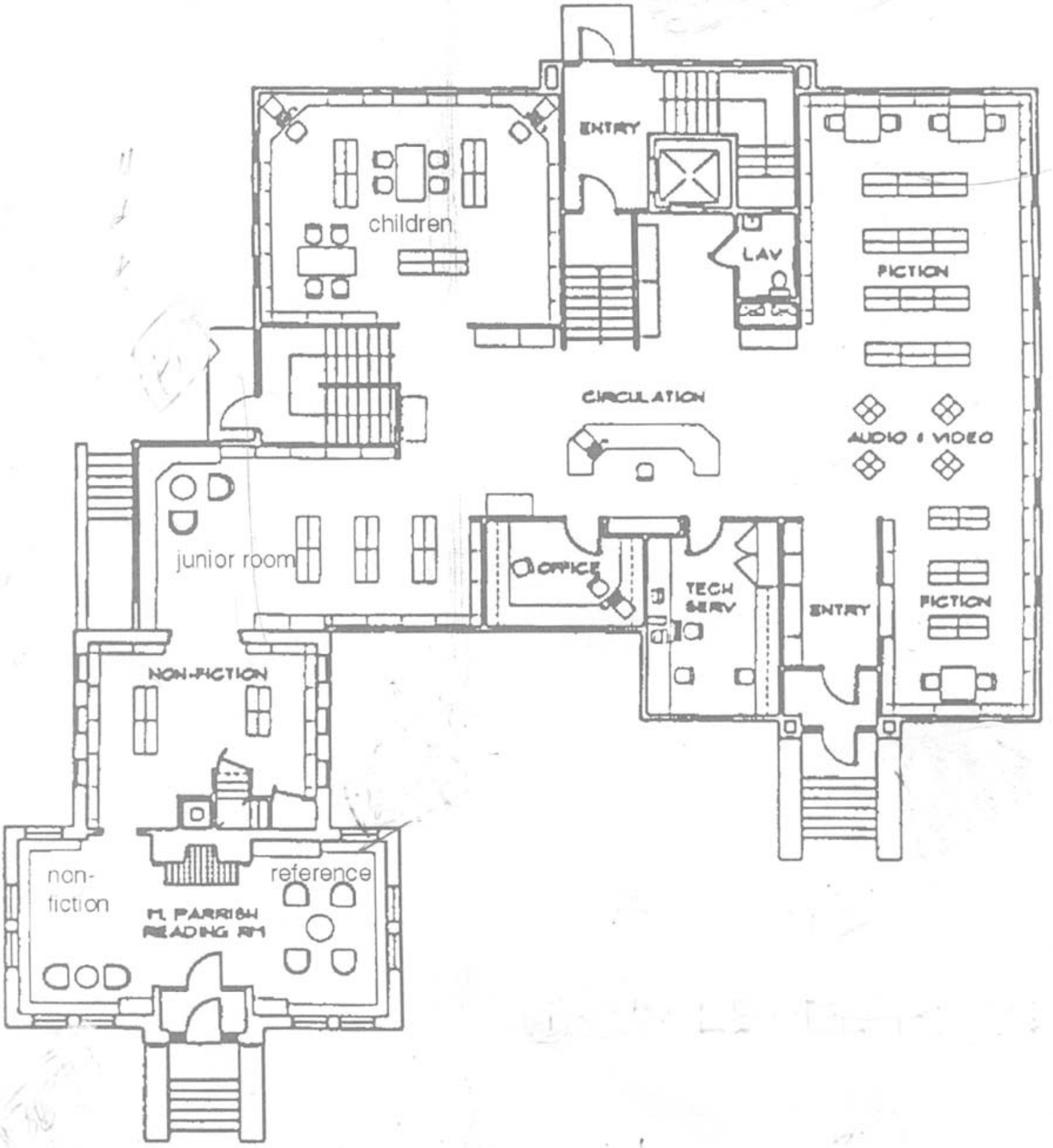
Once the facility site review and data measurements are substantially complete, the auditor begins reviewing and processing all of the collected data. Any data gaps discovered during this process are addressed prior to completing the audit report. The information collected on site, including historic energy use data, and extensive photographs are analyzed to understand how energy is used in the building. From this comprehensive review and analysis, a series of energy conservation measures are developed to establish an estimate of net energy savings for each EEM. Capital investment costs for these measurements are developed, and based on the estimated cost savings associated with the energy reduction measure, the payback term calculated. Other noted recommendations relate to indoor air quality, code compliance, and life safety. .

Cost Estimating and Payback

The cost for implementing each evaluated EEM is then estimated by the Auditor. This provides a net estimated energy savings per dollar invested. Simple payback calculations determine the number of years required for the capital investment cost to equal the present day cost savings realized from energy reductions.

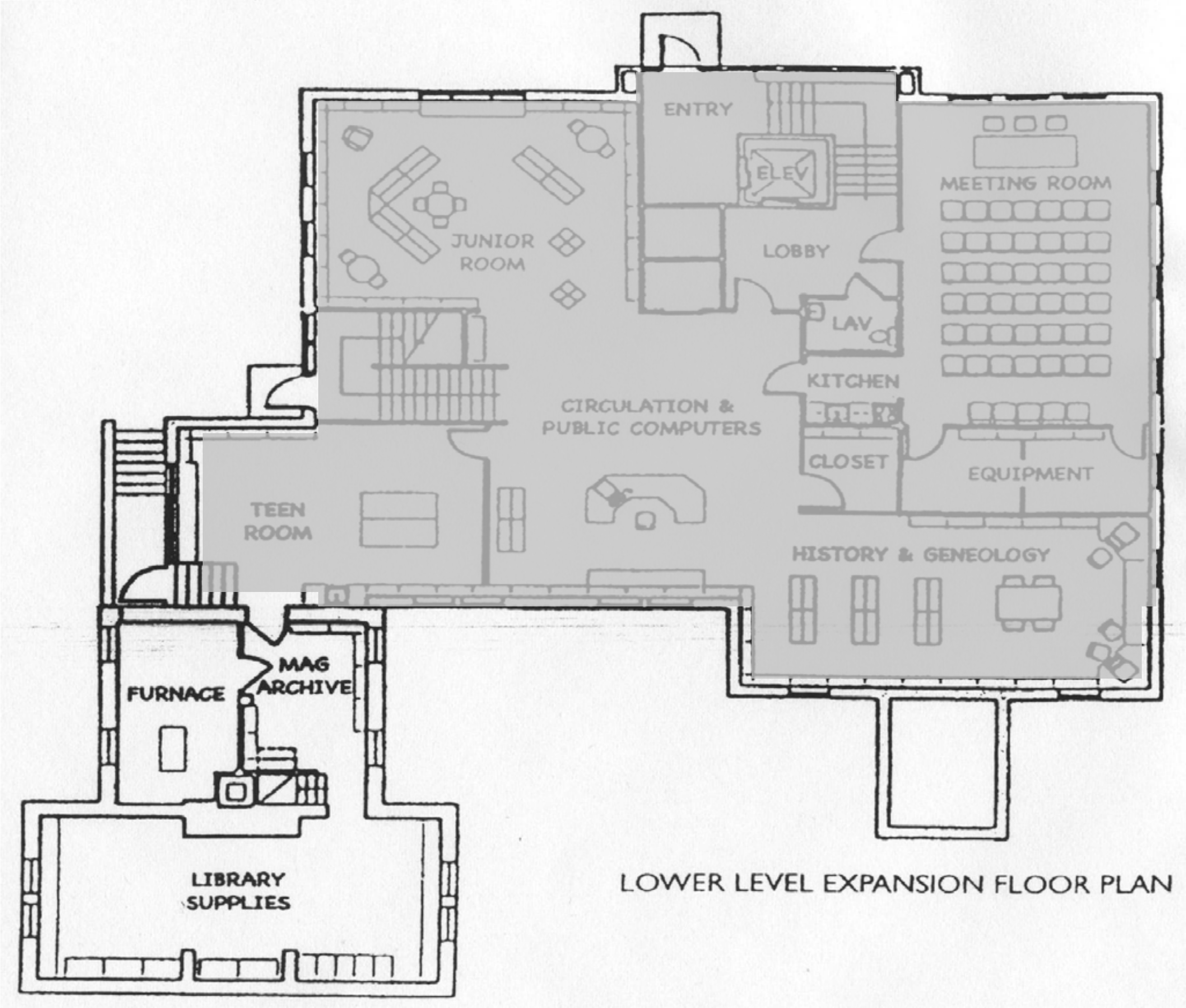
APPENDIX A

Floor Plan – Main Level



Lower Level

Shaded is not yet finished or occupied



LOWER LEVEL EXPANSION FLOOR PLAN

APPENDIX B

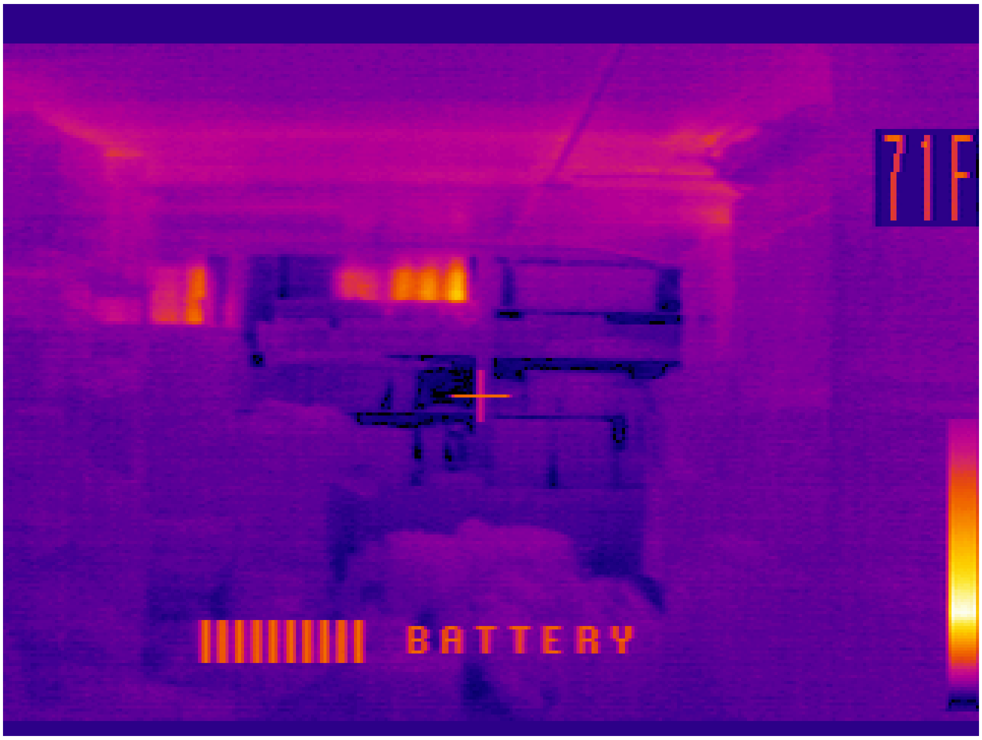
South Facing

West Facing

East

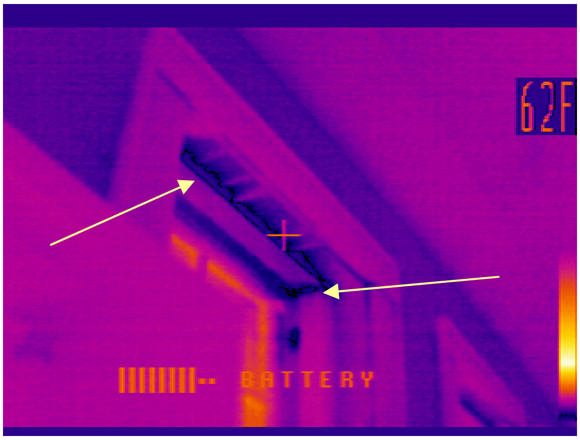
North

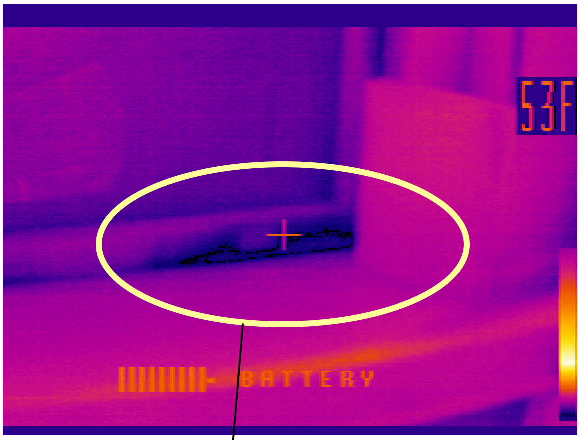
1920 Basement

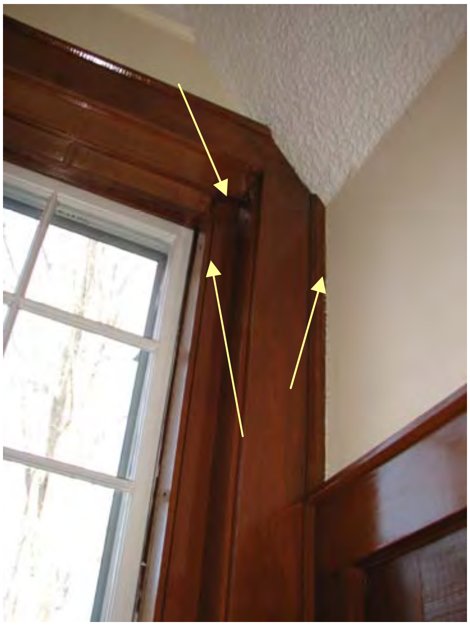


Air leakage sites

Air leakage sites

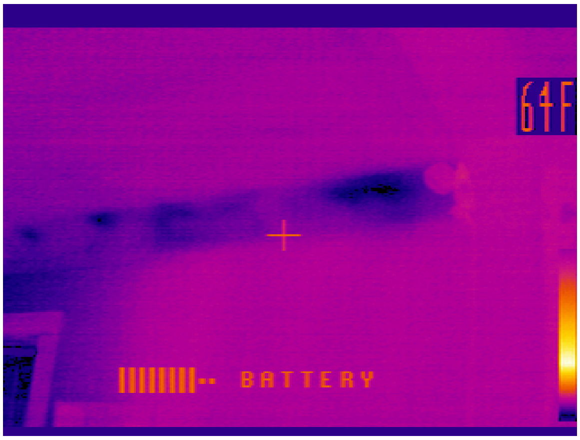


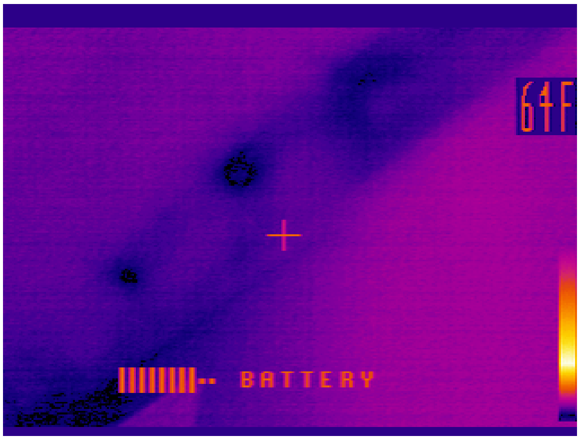


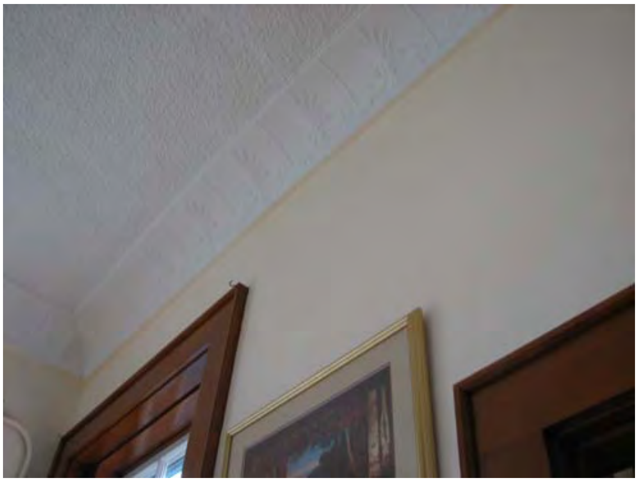


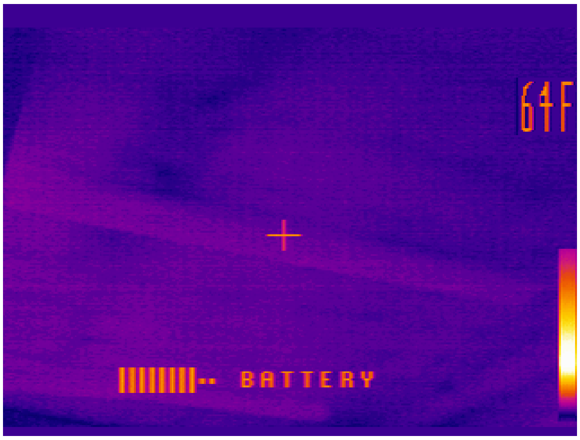
1920 walls have plaster on brick and no insulation

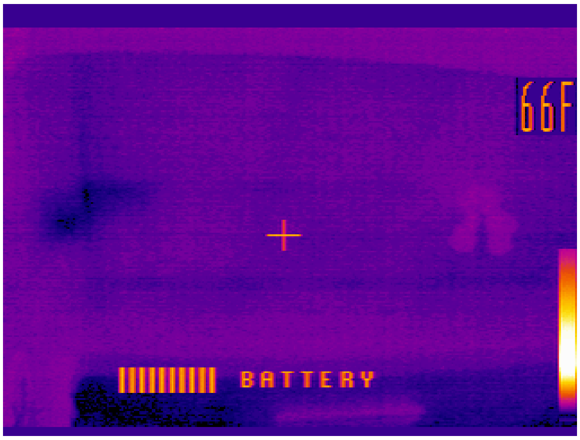
Voids and gaps in the insulation above the ceiling

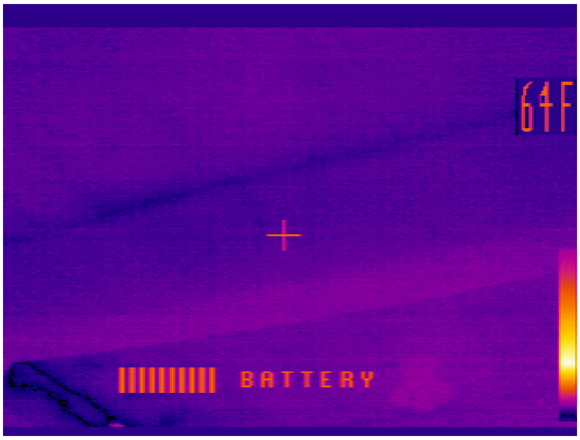




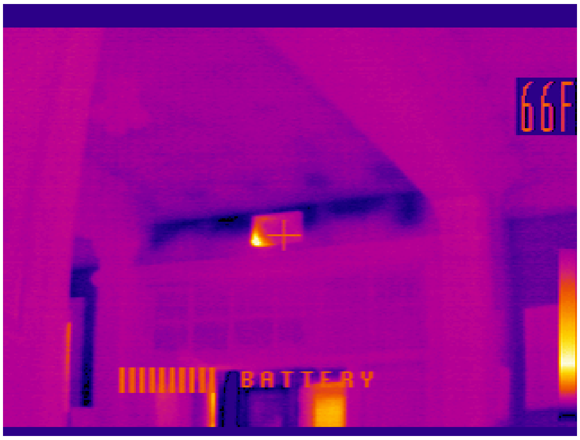








Faint darkness indicate deficiencies in the thermal barrier. Though the ceiling still outperforms the walls, it is less costly to improve.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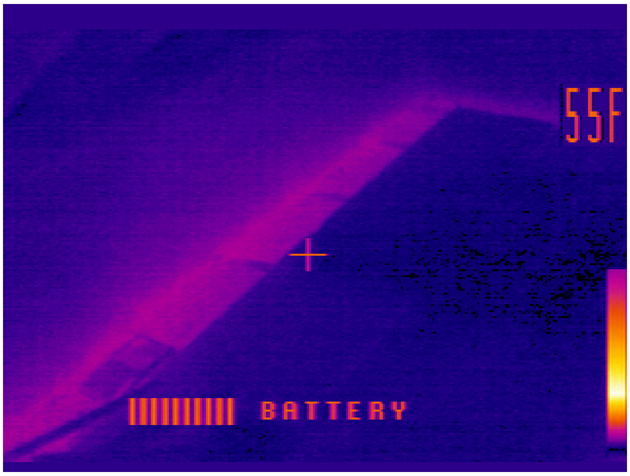
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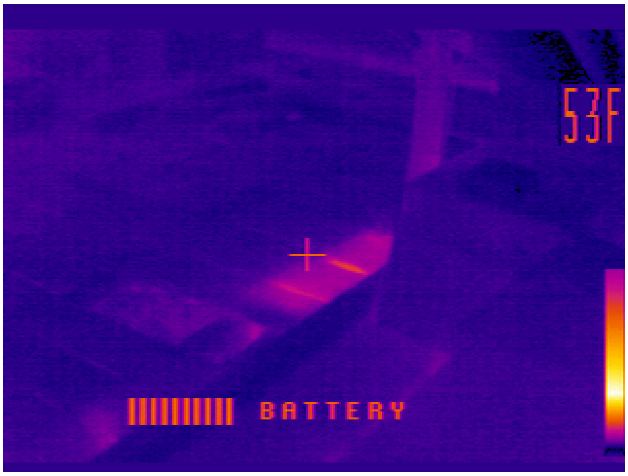
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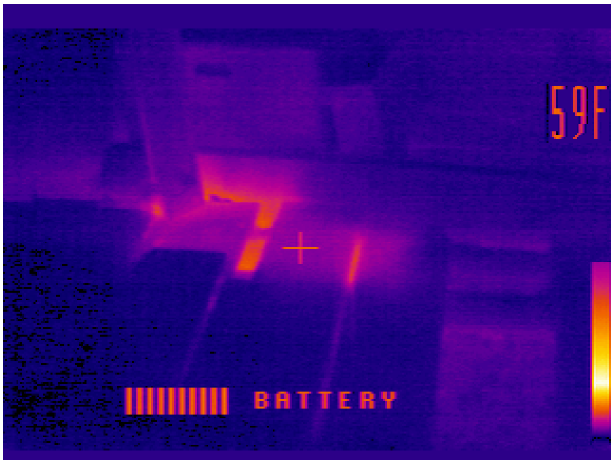
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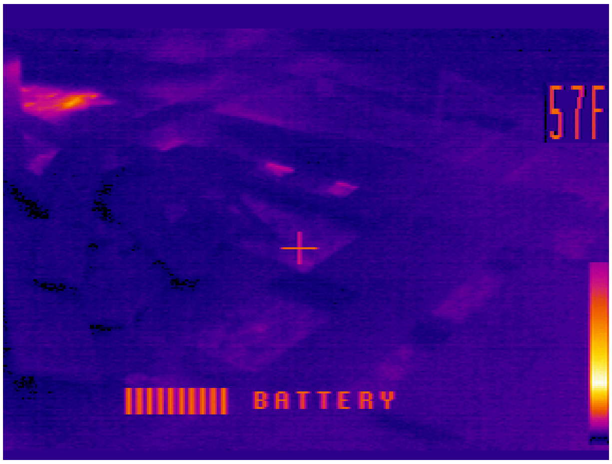
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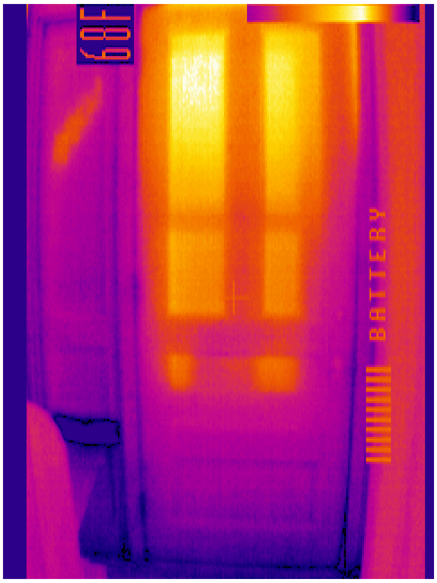
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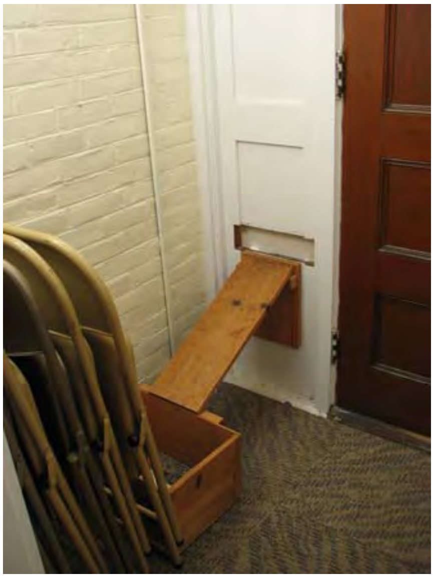

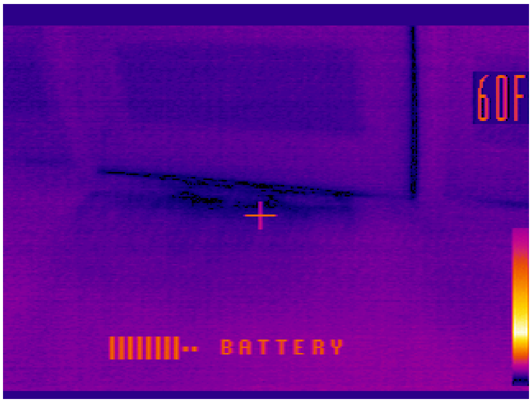
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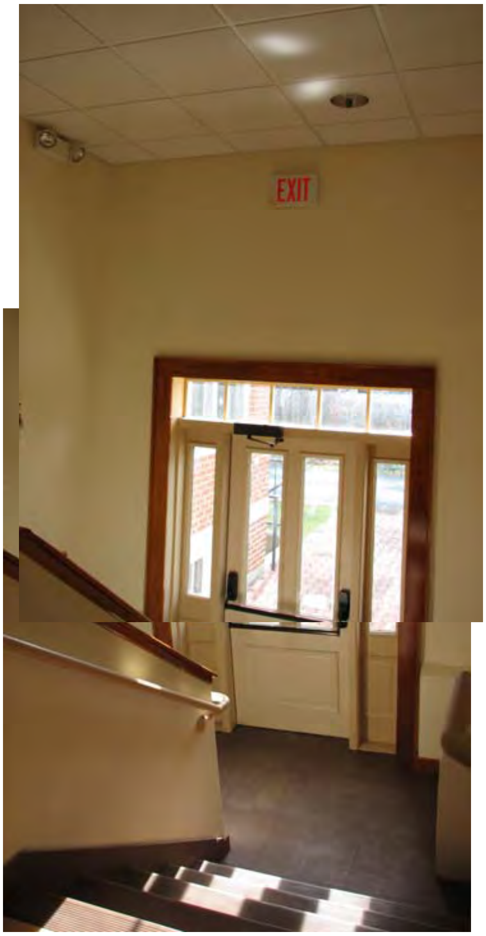
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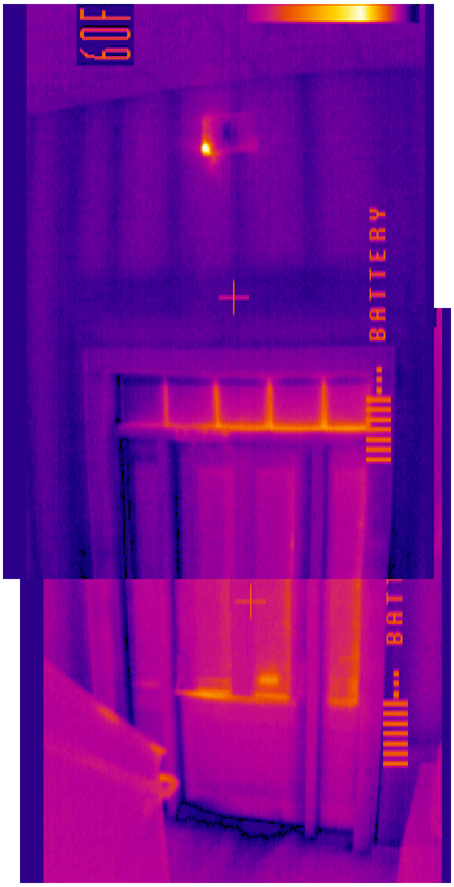
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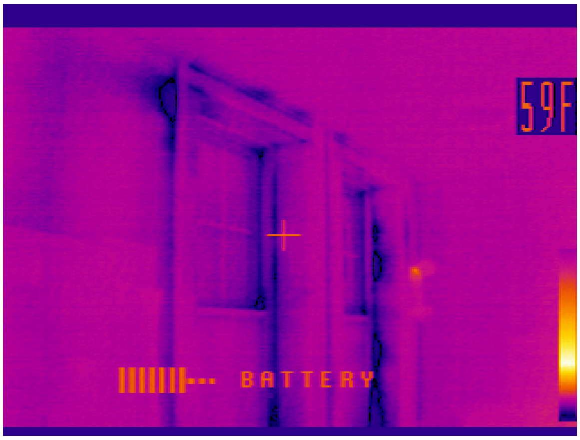
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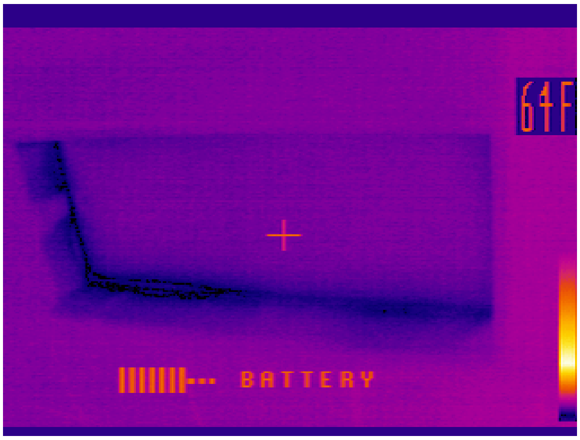
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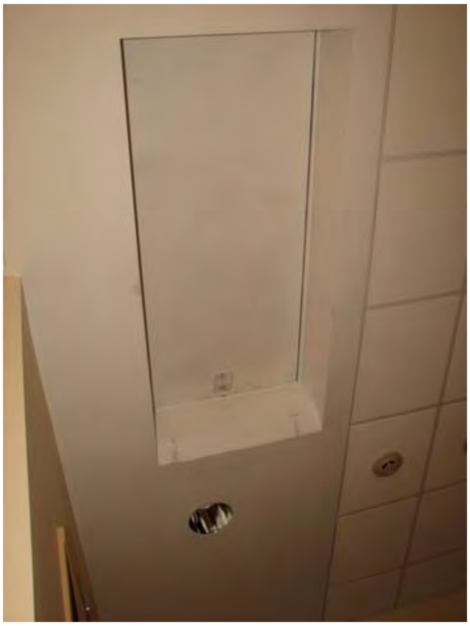


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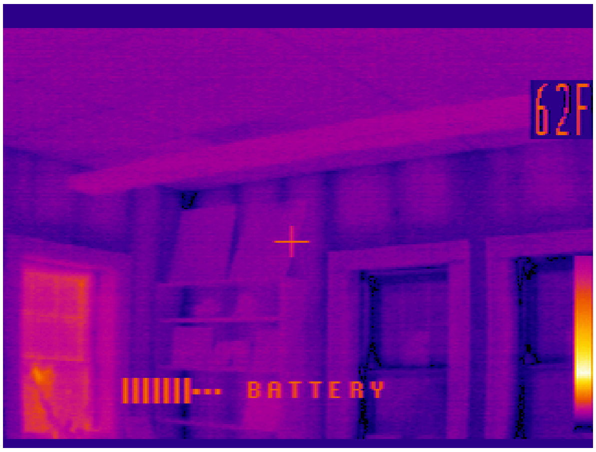
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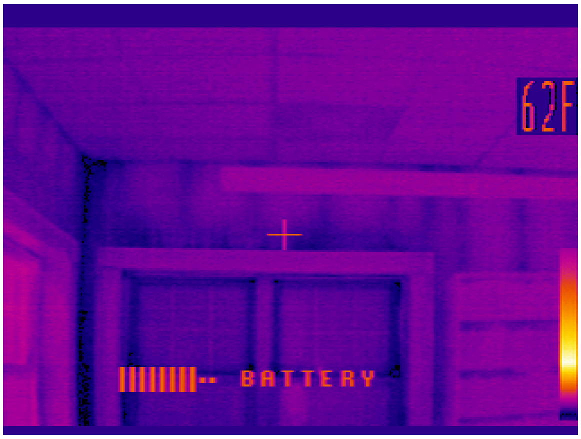
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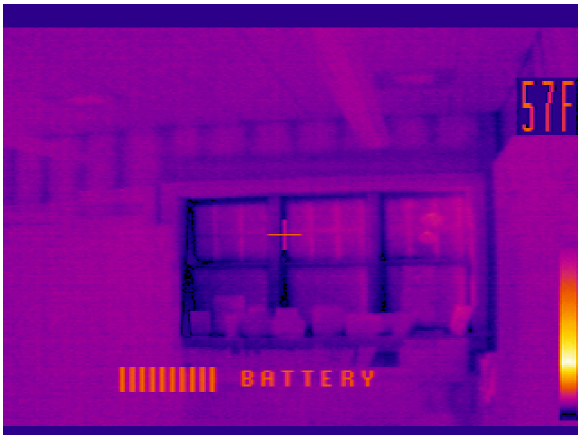
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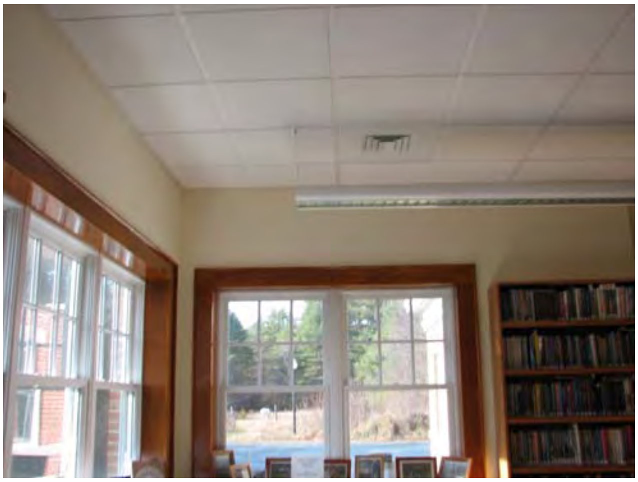


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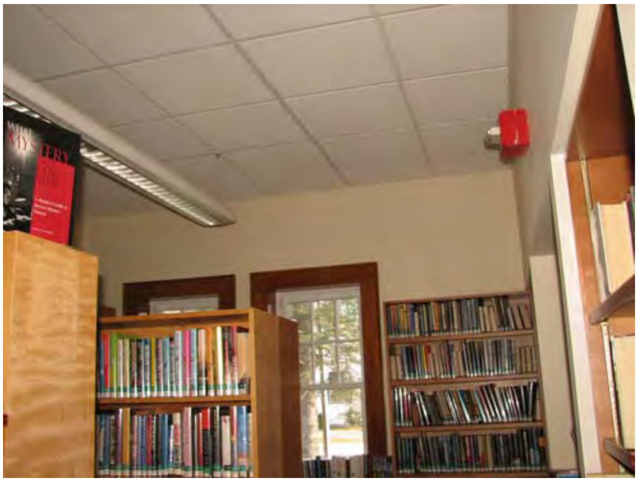

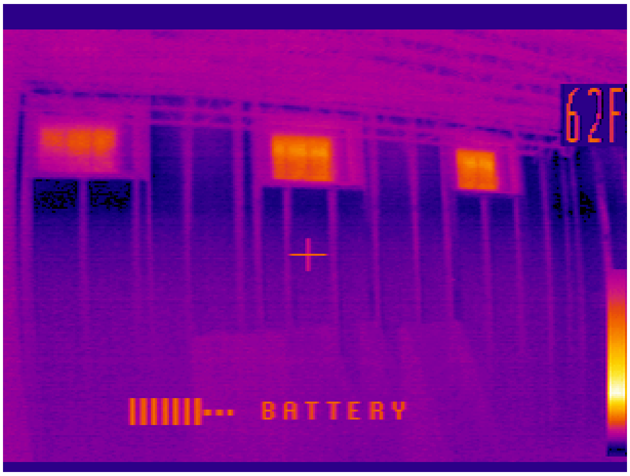
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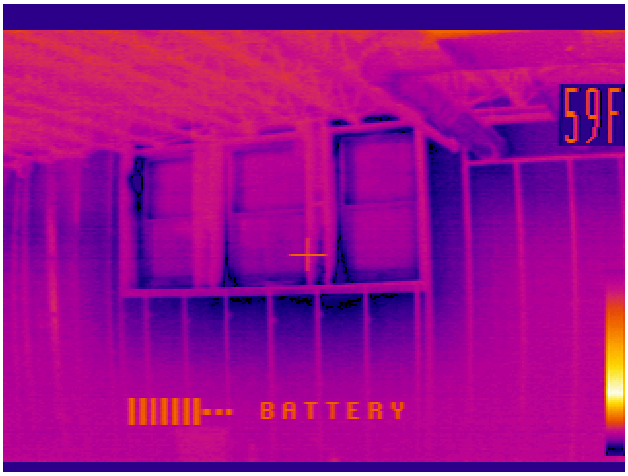
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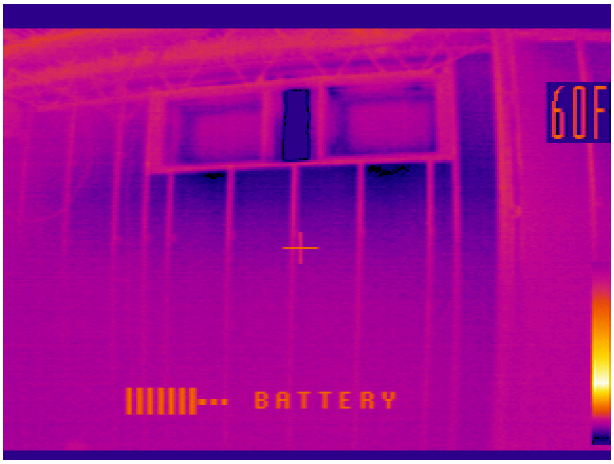
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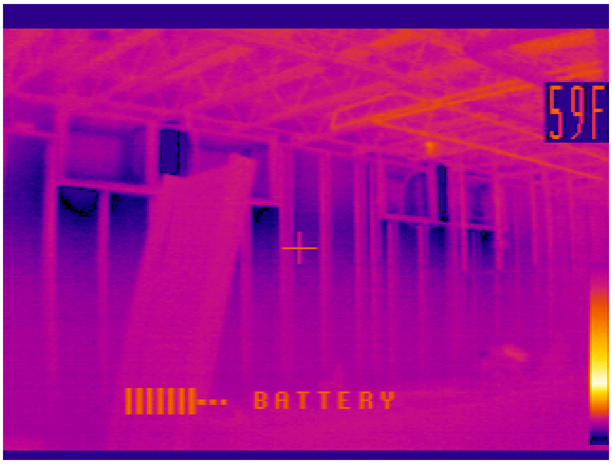
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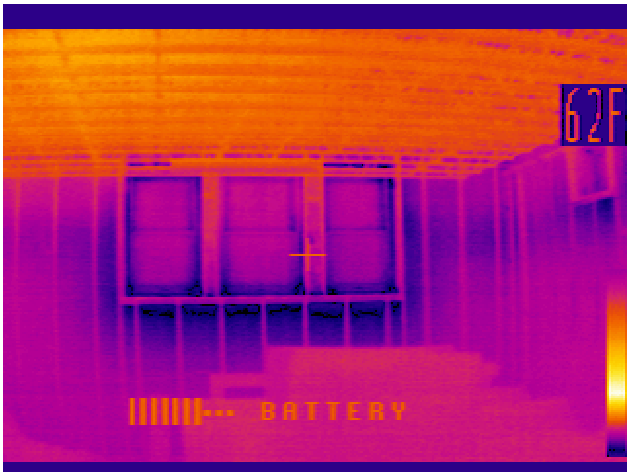
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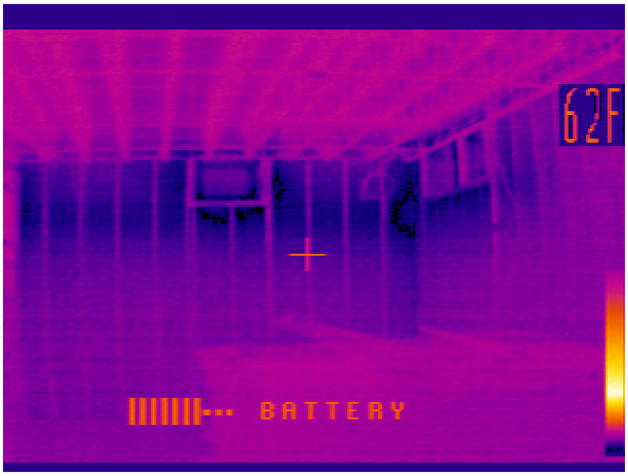
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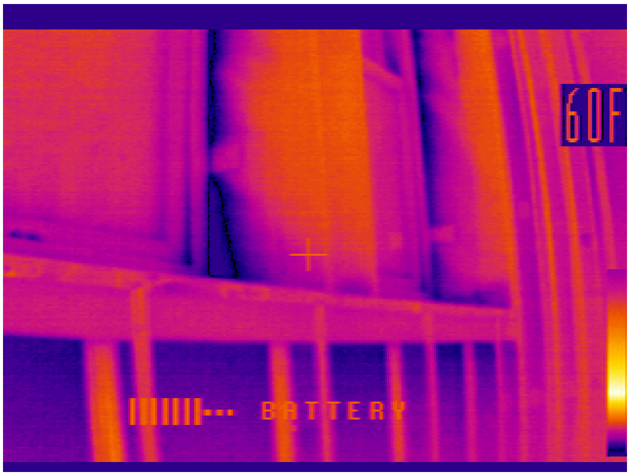
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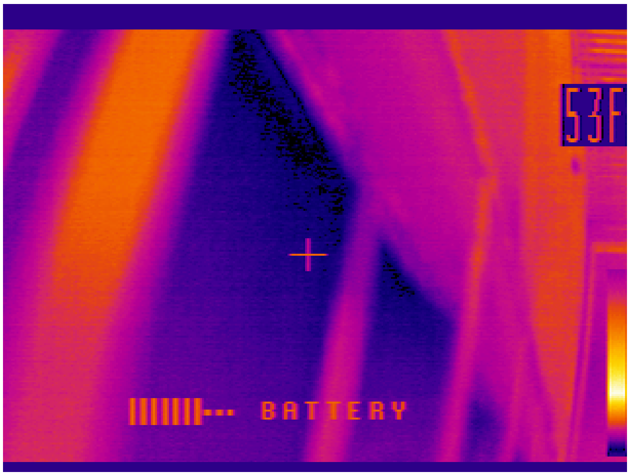
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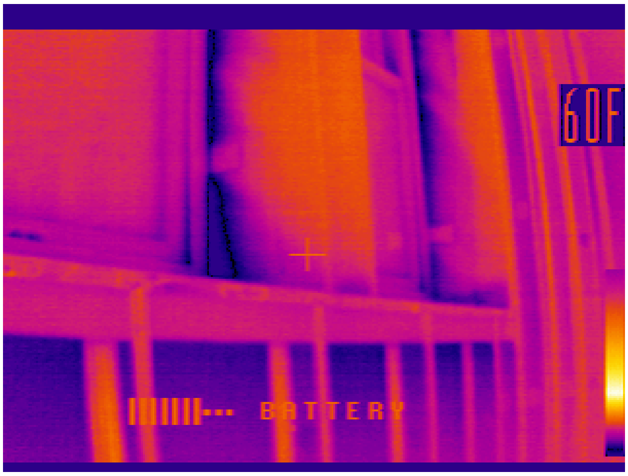
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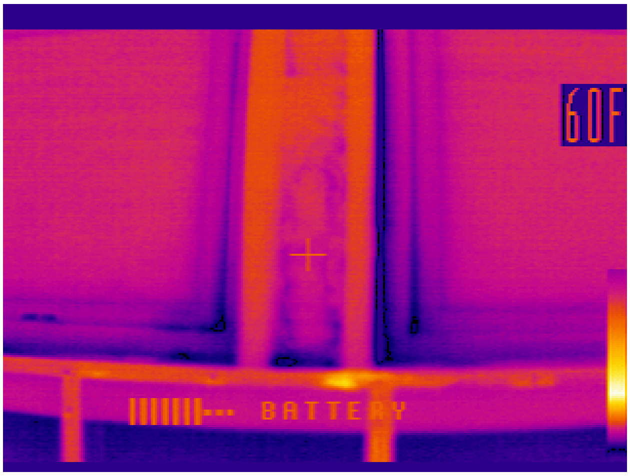
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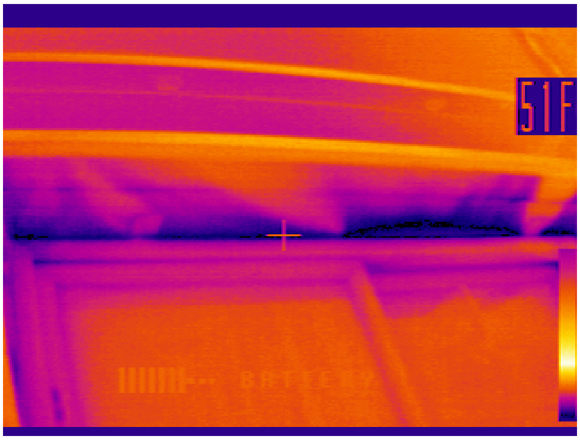
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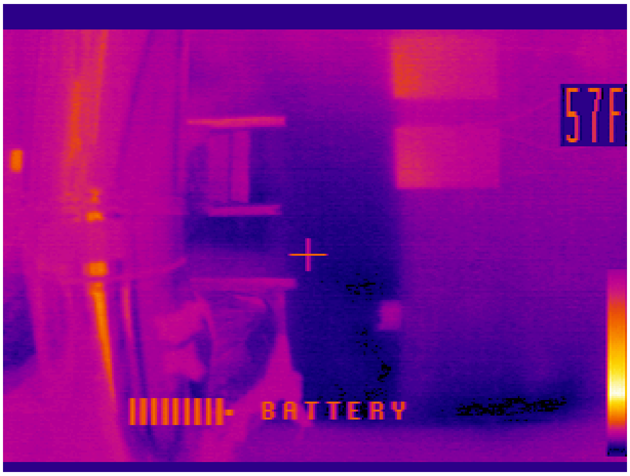
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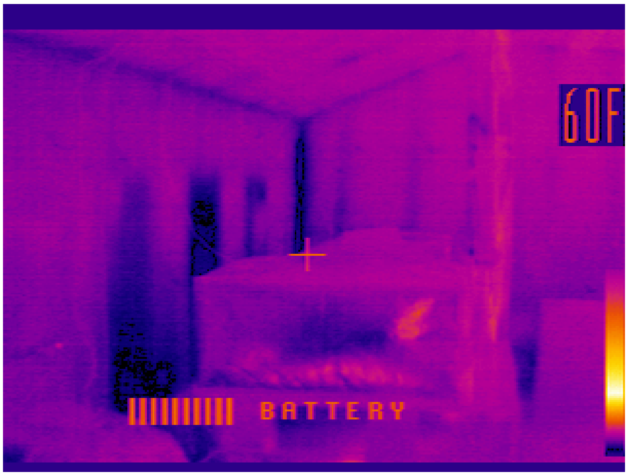
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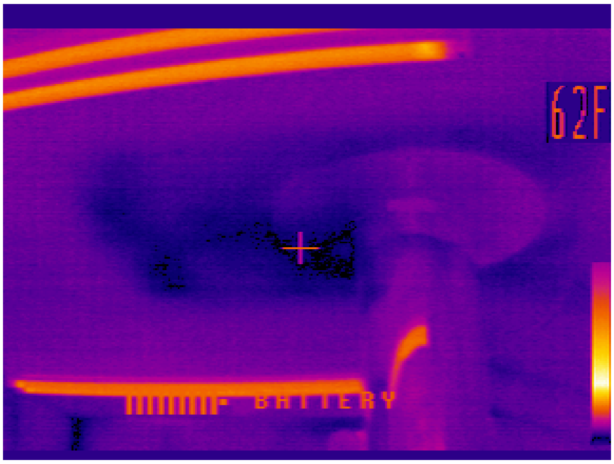
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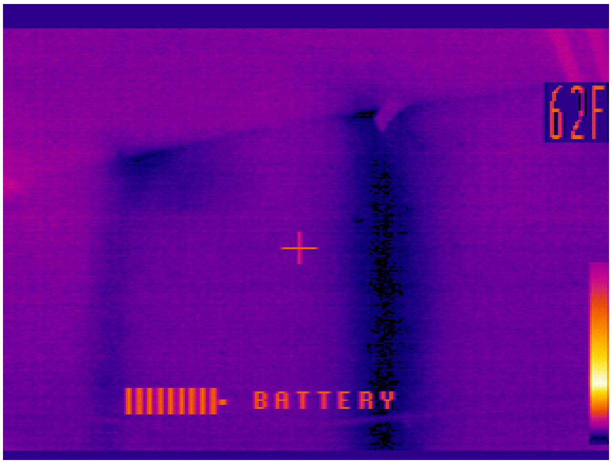
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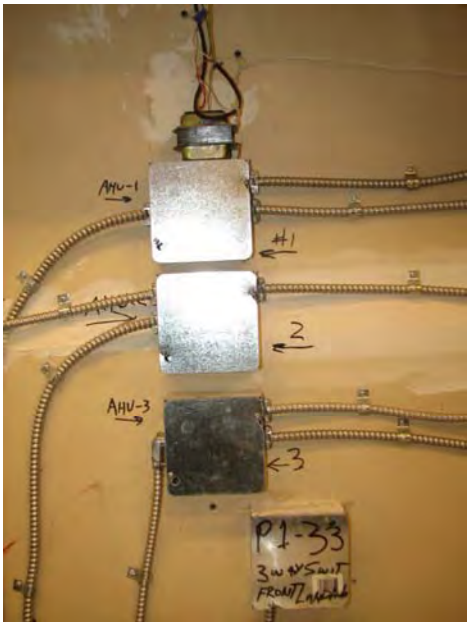
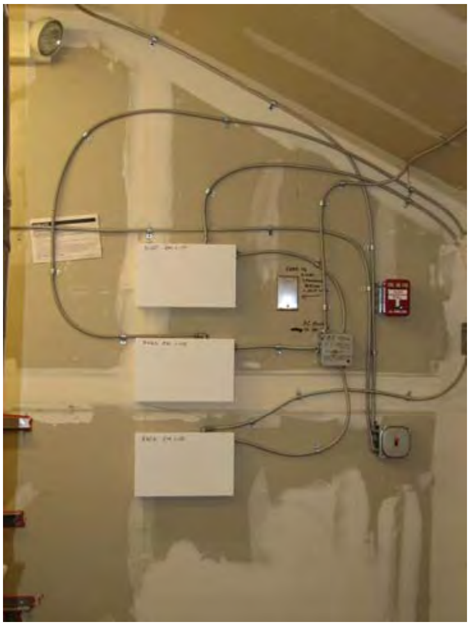
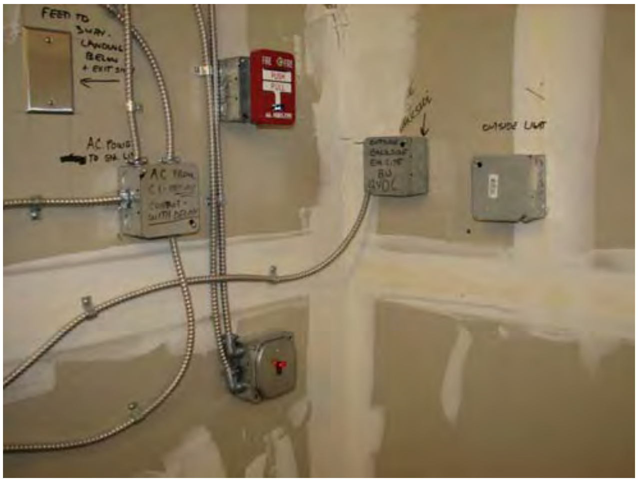
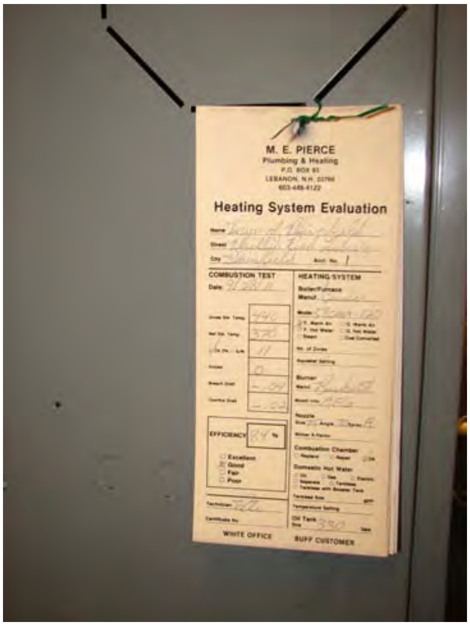
FRAGILE
COMMERCIAL-INDUSTRIAL
AIR FILTERS

Controls in the Attic Furnace Room









M. E. PIERCE
Plumbing & Heating

Heating System Evaluation

COMBUSTION TEST

HEATING SYSTEM

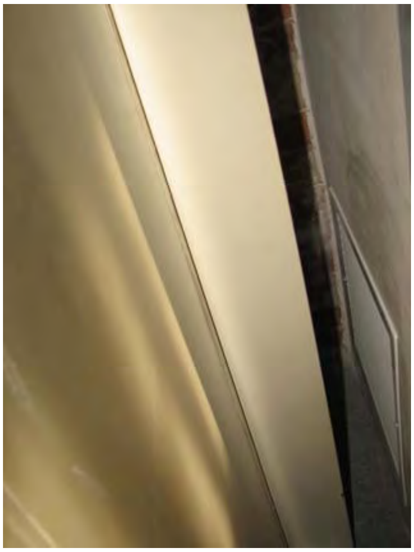
EFFICIENCY 84 %

☐ Excellent
☒ Good
☐ Fair
☐ Poor

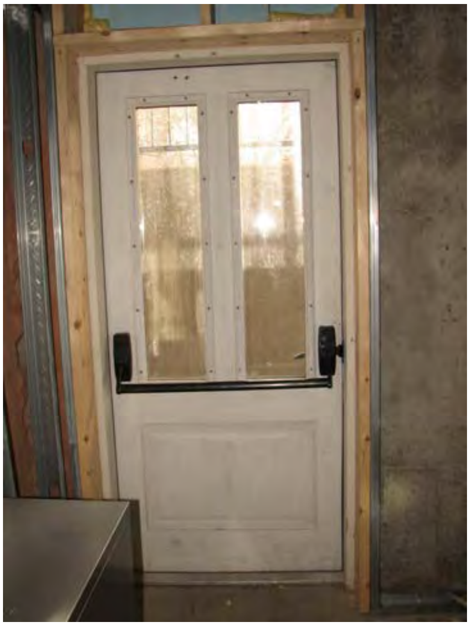
Oil Tank Size 330

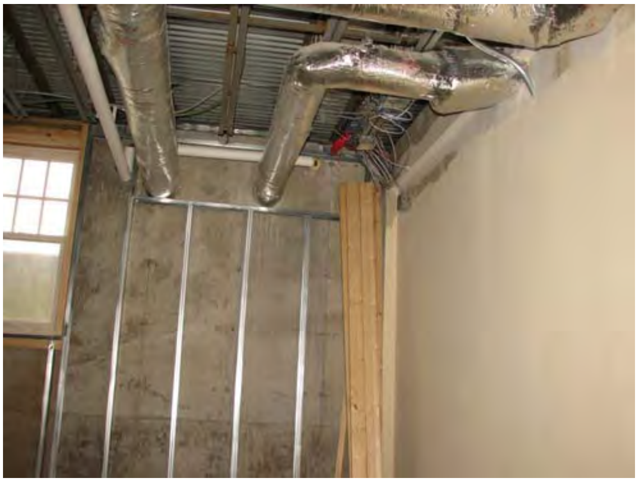
WHITE OFFICE BUFF CUSTOMER


PLAYBILL
NEW HAMPSHIRE TO DO
CADRES POUR CHEMI



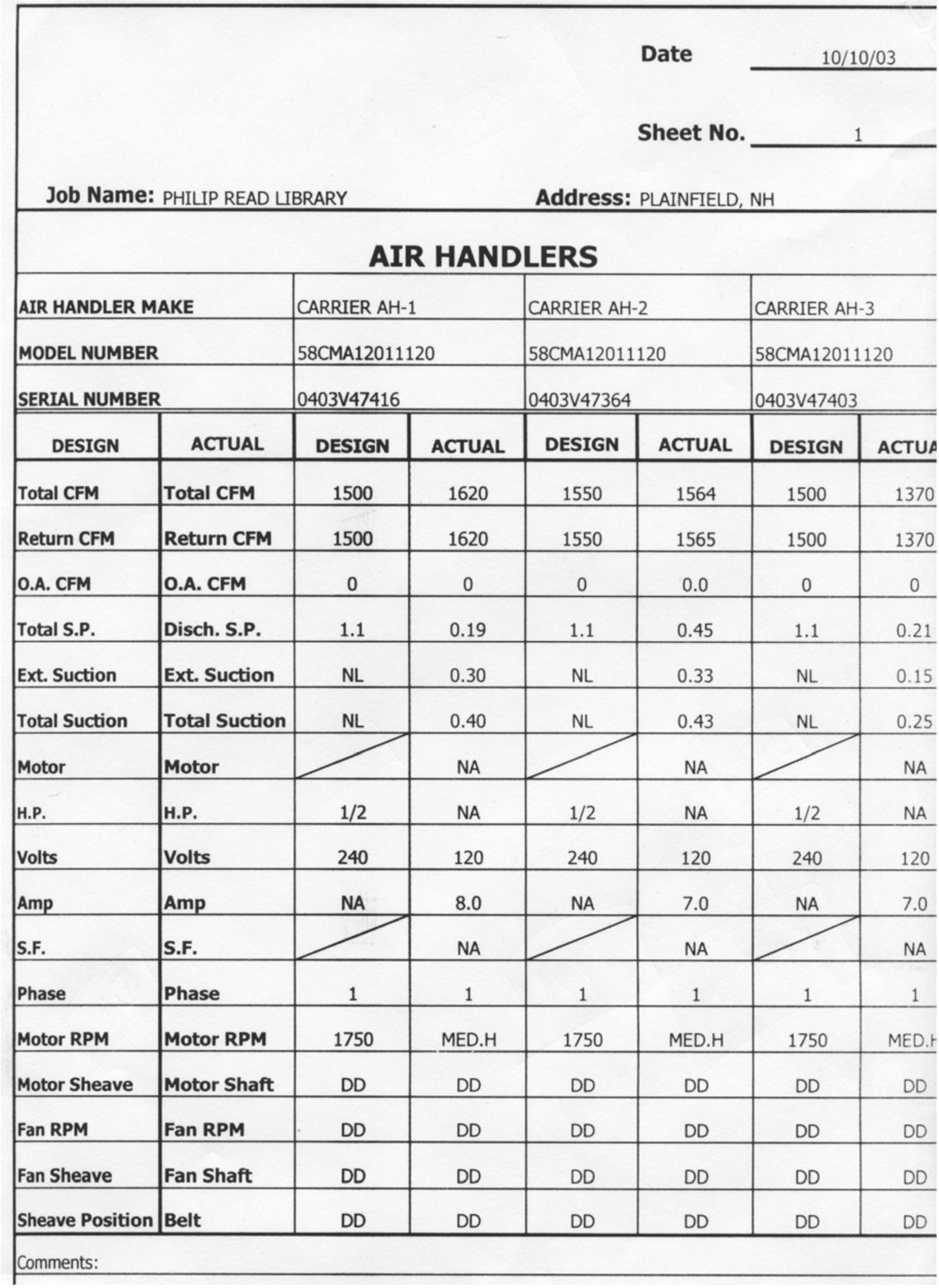

COMMERCIAL STANDARD CS195-60
WILLIAMSON






EXIT

APPENDIX C



Date 10/10/03

Sheet No. 1

Job Name: PHILIP READ LIBRARY **Address:** PLAINFIELD, NH

AIR HANDLERS

AIR HANDLER MAKE		CARRIER AH-1		CARRIER AH-2		CARRIER AH-3	
MODEL NUMBER		58CMA12011120		58CMA12011120		58CMA12011120	
SERIAL NUMBER		0403V47416		0403V47364		0403V47403	
DESIGN	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUAL**	**DESIGN**	**ACTUA**
Total CFM	**Total CFM**	1500	1620	1550	1564	1500	1370
Return CFM	**Return CFM**	1500	1620	1550	1565	1500	1370
O.A. CFM	**O.A. CFM**	0	0	0	0.0	0	0
Total S.P.	**Disch. S.P.**	1.1	0.19	1.1	0.45	1.1	0.21
Ext. Suction	**Ext. Suction**	NL	0.30	NL	0.33	NL	0.15
Total Suction	**Total Suction**	NL	0.40	NL	0.43	NL	0.25
Motor	**Motor**		NA		NA		NA
H.P.	**H.P.**	1/2	NA	1/2	NA	1/2	NA
Volts	**Volts**	240	120	240	120	240	120
Amp	**Amp**	NA	8.0	NA	7.0	NA	7.0
S.F.	**S.F.**		NA		NA		NA
Phase	**Phase**	1	1	1	1	1	1
Motor RPM	**Motor RPM**	1750	MED.H	1750	MED.H	1750	MED.
Motor Sheave	**Motor Shaft**	DD	DD	DD	DD	DD	DD
Fan RPM	**Fan RPM**	DD	DD	DD	DD	DD	DD
Fan Sheave	**Fan Shaft**	DD	DD	DD	DD	DD	DD
Sheave Position	**Belt**	DD	DD	DD	DD	DD	DD

Comments:

Date 10/10/03

Sheet No. 2

Job Name: PHILIP READ LIBRARY **Address:** PLAINFIELD, NH

EXHAUST FAN

FAN I.D.	EF-A/004	EF-B/003	EF-A/204			
FAN MAKE	PENN	PENN	PENN			
MODEL #	ZEPHERETTE	Z85HRATD	ZEPHERETTE			
SERIAL #	NL	NL	NL			
Des. DFM	75	225	75			
Act. CFM	68	212	70			
TOTAL S.P.						
MOTOR MAKE	AO SMITH	AO SMITH	AO SMITH			
Des. H.P.	0.09	1/2	0.09			
Act. H.P.	1/80	1/20	1/80			
Des. Volt	115	115	115			
Act. Volt	120	120	120			
Des. Amp	.5	1.4	.5			
Act. Amp	.4	1.0.	0.4			
S.F.	TP	TP	TP			
PHASE	1	1	1			
MOTOR RPM	1200	1150	1200			
FAN RPM	1200	1150	1200			
MOTOR SHEAVE	DD	DD	DD			
FAN SHEAVE	DD	DD	DD			
SHEAVE POSITION	DD	DD	DD			
BELT SIZE	DD	DD	DD			

COMMENTS:

Date 10/10/03

Sheet No. 3

Job Name: PHILIP READ LIBRARY **Address:** PLAINFIELD, NH

	Outlet			Effective	Specified		Actual			
oom Number	Number	Code	Size	Area	F. P. M.	C.F.M.	F. P. M.	C.F.M.		
	AH-1	DUCT	20x12	1.6	937	1500	1012	1620		
LOWER	1	WG	16x8	1.0		400		420		
LOWER	2	WG	12x8	1.0		300		345		
LOWER	3	WG	22x12	1.0		800		825		
					TOTAL	1500		1590		
	AH-	2	22x10	1.5	1033	1550	1043	1565		
205	1	CD	2'x2'	1.0		125		129		
205	2	CD	2'x2'	1.0		125		125		
205	3	CD	2'x2'	1.0		125		125		
205	4	CD	2'x2'	1.0		125		120		
206	5	CD	2'x2'	1.0		125		130		
206	6	CD	2'x2'	1.0		125		134		
209	7	CD	2'x2'	1.0		125		122		
212	8	CD	2'x2'	1.0		100		110		
212	9	CD	2'x2'	1.0		100		112		
212	10	CD	2'x2'	1.0		100		100		
211	11	CD	2'x2'	1.0		150		146		
210	12	CD	2'x2'	1.0		225		165	DAMPER OPEN	
					TOTAL	1550		1518		

Sheet code

Type	Code	Model	MFG	Remarks

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Plainfield Library

Building ID: 3024326
For 12-month Period Ending: December 31, 2011[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: February 13, 2012

Facility
Plainfield Library
1088 Rt. 12A
Plainfield, NH 03781

Facility Owner
TRC Energy Services
155 Fleet Street
Portsmouth , NH 03801

Primary Contact for this Facility
N/A

Year Built: 1920
Gross Floor Area (ft^2): 8,014

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	50,992
Fuel Oil (No. 2) (kBtu)	311,221
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	362,213

Energy Intensity[4]	
Site (kBtu/ft^2/yr)	45
Source (kBtu/ft^2/yr)	60

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	29

Electric Distribution Utility
Public Service Co of New Hampshire [Northeast Utilities]

National Median Comparison	
National Median Site EUI	70
National Median Source EUI	127
% Difference from National Median Source EUI	-52%
Building Type	Other

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[5] **for Indoor Environmental Conditions:**	
Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16