

Energy Audit

With Funding From
Liberty Utilities



Meriden Fire Station
Plainfield, New Hampshire

March 26, 2020

Audit Prepared by



Table of Contents

Introduction	3
Executive Summary	3-4
Exterior Photos—Reference	5
Historic Energy Data	6
Thermographic Images with ESM Notes	7-11
Wall Images	12
Heating Equipment	13
Appliances	14
Inputs and Assumptions: Rhvac Calcs	
Existing Conditions	15-23
Following ESM 1	24-28
Following ESM 2	29-33
Following ESM 3	34-38
Following ESM 4	39-43
Following ESM 5	44-48
Elite Energy Audit Report	49-59

Introduction

This Energy Audit has been partially funded by Liberty Utilities. Funds may also be available to help reduce cost for eligible Energy Saving Measures (ESM) including weatherization efforts, lighting and equipment upgrades.

The purpose of an energy audit is to identify ESM in a building. Computer simulated and other energy models were developed for this project using multiple strategies and software. The models estimate predicted future energy consumption based on the local climate conditions, physical dimensions and characteristics of a building, mechanical systems, presumed lighting, equipment, and occupancy patterns, in addition to a number of other variables.

With the building modeled in existing conditions, energy savings can be estimated for improvements to the thermal envelope. The cost of those measures can then be analyzed in terms of predicted energy saved. The primary objective is to evaluate the level of investment warranted by energy and dollars saved from those specific measures. In many cases, as in this one, improving the thermal envelope is expected to yield 'non energy saving' benefits, such as improving occupant comfort and reducing the size of any future HVAC equipment.

This audit has been prepared with the best of intentions to assist the Town of Plainfield make informed decisions regarding energy improvements. We do not make any warranty, expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed.

Executive Summary

The Meriden Fire Station is a wood framed, slab on grade building with three garage bays, a meeting room with kitchen and office, and an unconditioned storage room off the boiler room. The original building was constructed in the 1950's. Occupancy is periodic and unpredictable.

The walls and ceilings are insulated with fiberglass. At some point, the walls were re-sided with cement board over one inch polyiso. There are six double pane windows in wood frames. Three conditioned garage bays are accessed by three insulated overhead doors in relatively good condition. The building is heated hydronically by a fairly new Buderus oil fired boiler with Logamatic Controls.

A summary of the recommended ESM is in the table below. The total investment is estimated at \$6,876 and can be expected to save \$654 a year in heating costs at \$2.62 per gallon of oil. This would show a simple pay back of 10.3 years and an annualized Return on Investment (ROI) of 14% per year over the 25 year life of measures. Annual energy savings are estimated at 250 gallons of oil; 34.6 MMBtus; and 2.9 tons of GHG emissions

ESM #	ESM Target Area	Annual Savings	Cost of Measure	Gallons Oil Saved	Energy Savings MMBTU	Simple Payback Yrs	Life of Measure	Investment Gain	ROI	Annual ROI
1	Air Sealing Package	\$216	\$851	82	11.4	3.9	15	\$11,911	1399.6%	19.8%
2	Meeting Room Ceiling Chase	\$132	\$1,394	50	7.0	10.6	25	\$31,050	2399.5%	13.7%
3	Bay Ceiling to R50	\$165	\$3,014	63	8.7	18.3	25	\$63,931	2399.8%	13.7%
4	Meeting Room Ceiling to R50	\$68	\$1,058	26	3.6	15.6	25	\$25,392	2400.0%	13.7%
5	Slab Edge Insulation	\$73	\$560	28	3.9	7.7	25	\$13,440	2400.0%	13.7%
TOTALS		\$654	\$6,876	250	34.6	10.5	24	\$156,525	2276.4%	14.1%

ESM Notes and Descriptions

ESM PACKAGE #1

Air Sealing Package - Photos on page 7

Overhead Door Sealing: Robust weather-stripping for the bottom seal is available from American Garage Door Supply. It appears that vertical weatherstripping is in fairly good condition though several small sections have failed, so spot replacement is recommended.

Photo to the right shows the Ultra Rubber Bottom Seal at \$2.80 per foot from American Door Supply <https://americadoorsupply.com/>



Window and Door Weather-stripping: There are six double hung windows and two exterior doors in need of new weather-stripping.

“Thermodome”: Access to the attic was found above the suspended ceiling on the southeast wall between the door and office. Comprehensive air sealing of the ceiling plane is part of ESM #2, but this measure allows for creating a functioning thermodome to access the attic floor.

ESM #2

Meeting Room Ceiling Chase— Photos on page 8 & 9

The target area of this ESM is the chase between the suspended ceiling and insulation layer of the attic. The goal is to air seal and insulate the wall perimeter of the chase with a minimum of 2” closed cell foam and tape seal the rigid material layer holding the fiberglass. The cost estimate of \$1394 is based on cutting t&g ends, then spraying 2” SPF on the exterior walls of the chase and labor involved in tape sealing all seams and penetration—securing the boards as necessary. A more costly option would be to remove the suspended ceiling altogether and install a new layer of drywall. This could be in conjunction with converting T8 lighting fixtures with LED. The expense of this ceiling upgrade is not justifiable on energy savings alone, but suggested for your consideration. LED conversion is recommended, however not part of this Audit due to the limited—and unknowable—hours that lighting is used.

ESM #3

Air Seal and Insulate Garage Bay Ceiling to R50 — Photos on page 10

Air seal all ceiling penetrations from below, then blow a minimum of 10” cellulose insulation above the existing insulation. NOTE: The existing insulation could not be inspected and may warrant removal if contaminated with rodent urine. Based on IR images, it does not appear to be compromised, with only a few voids. Ideally, fiberglass is always removed and new cellulose—or rockwool—blown in to even layers of at least 18”. However, the cost of removal cannot easily be justified by energy savings, since the existing layers appear to be performing relatively well. The added material—and eliminating thermal bridging—is expect to bring the ceiling plane up to 2015 code levels.

ESM #4

Insulate Meeting Room Ceiling to R50 - Please refer to the description above for Garage Bay Ceiling.

ESM #5

Slab Edge Insulation—Photos on page 11

The goal of this measure is to extend exterior insulation from the existing polyiso layer on exposed slab edge to below grade on the perimeter of the meeting room. Costs reflect labor to dig a six inch trench, adhere Roxul comfort board, cover with metal flashing material and hand back fill.



Exterior Photos



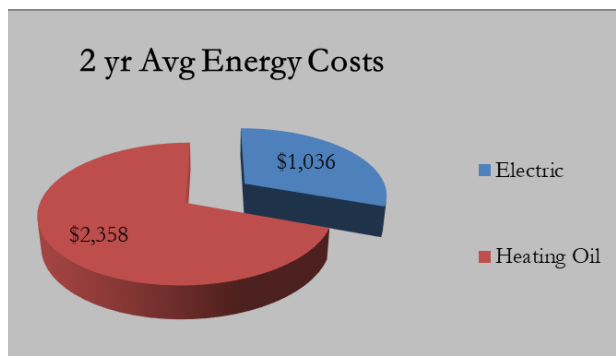
Historic Energy Usage

The energy analysis below is based on an average of historic energy use for the years 2017 and 2019 and 2019 energy prices.

Energy	Units	Site Btus	Source Btus	\$Cost
Electric kWh	5,452	18,602,224	61,940,172	\$1,036
Heating Oil	900	124,650,000	143,347,500	\$2,358
Totals		143,252,224	205,287,672	\$3,394
EUI KBtu/FT ²	2728	52.5	75.3	\$1.24

The Energy Utilization Index (EUI) offers a simple snapshot analysis of a building’s energy use by looking at total amount of energy input (converted to Btu’s) divided by the floor area of conditioned space. “Site Energy” refers to units of energy delivered to a site. Source energy includes transmission and total raw energy the building requires

Based on the information provided, the Fire Station’s EUI is a relatively low 52.5 KBtu/ft², with Source Energy EUI at 75.3 KBtu/FT². Based on 2019 energy prices, the total energy costs at \$1.24 per sq ft.



As shown above, heating costs represent over 70% of the annual energy costs. The recommended ESM in this study focus mostly on reducing oil consumption by improving the thermal envelope, thereby conserving heating energy.

Converting all lighting to LED will save energy and reduce replacement maintenance costs. However the lights are used so infrequently, the simple payback may exceed 10 years.

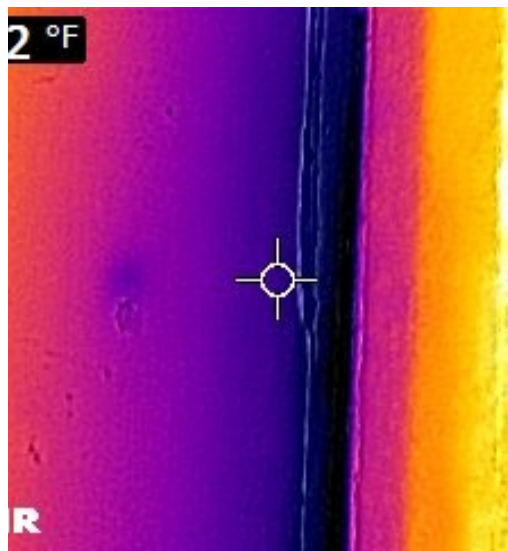
Appliances are inventoried on page 14. The chest freezer is believed to be 19 years old. Newer chest freezers are far more efficient and could save 300-400 kWh a year at a minimum. However, the compressors don’t last as long as older models (same goes for refrigerators), so replacing large units can be hard to justify based on dollar savings alone. As note on page 14, keeping them full also saves energy. Use gallon jugs of water or bags of ice to fill cabinet.

	Summary of Envelope Measures	Heating Load Btu/Hr	Heating Cost	Gallons	Design Load Btu/FT
Exist		52,079	\$2,370	904	19.1
ESM1	Weatherstripping doors and windows and install thermodome	46,970	\$2,154	822	17.2
ESM 2	Meeting room chase perimeter and air seal ceiling dry wall	43,847	\$2,022	771	16.1
ESM 3	Bays ceiling insulation to R50	39,927	\$1,857	708	14.6
ESM 4	Meeting Room insulation to R50	38,310	\$1,789	682	14.0
ESM 5	Slab Edge Insulation	36,584	\$1,716	655	13.4

Load calculations from Elite Rhvac; Reports included at the end of this report.

ESM 1 Air Sealing Measures

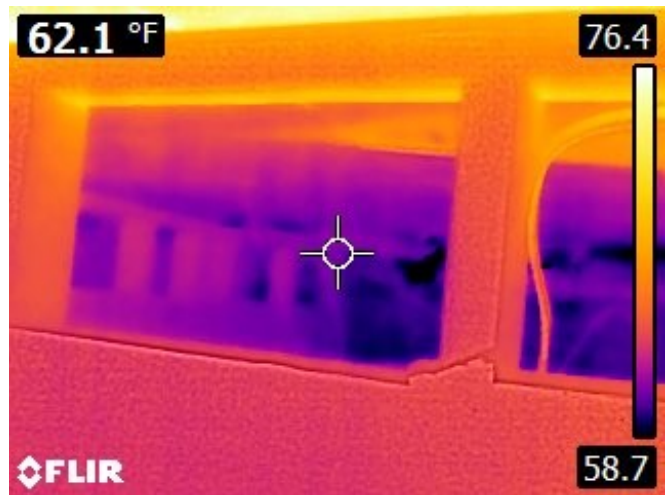
Add weatherstripping to bottom of all overhead doors and as needed to vertical rails.



ESM 2 Meeting Room Ceiling and Chase Perimeter

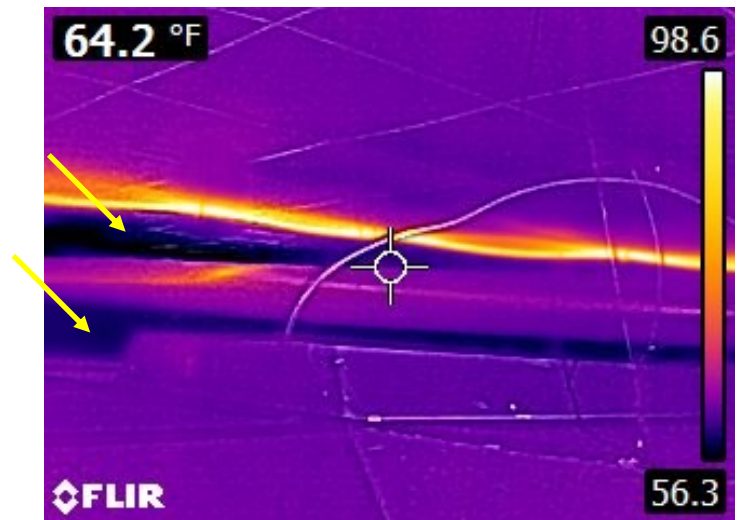
The meeting room has ceiling tiles suspended below drywall, secured to ceiling joists with fiberglass batts between the bays. The drywall has penetrations, unsealed seams, and in some places, needs to be re-secured. Access above the drywall is through a hatch between the entry door and office. Full access up into the attic was not possible with the ladder available. However, it was clear by the condition of fiberglass that the hatch and surrounding area serves as an air pathway into the vented attic. Ideally, the fiberglass would be removed, the drywall secured and all seams and penetrations taped and sealed, and 16 inches of cellulose blown in, followed by a thermodome access hatch.

The exterior perimeter of the chase between the drywall and suspended ceiling is insulated with faced fiberglass but only partially enclosed with what appears to be tongue and groove paneling, or nothing at all. Replacing the fiberglass with closed cell foam would improve the thermal performance while also helping to air seal the cavity below. This would be especially beneficial as hot water pipes run the perimeter of exterior walls in this chase.



Dark areas indicate thermal bypasses to the outside.

Dark areas depict the transition from wall to the thermal barrier above the original ceiling. ESM 2 is intended to insulate the perimeter of the chase and establish an air and thermal barrier at this transition, as well as all seams of the ceiling itself

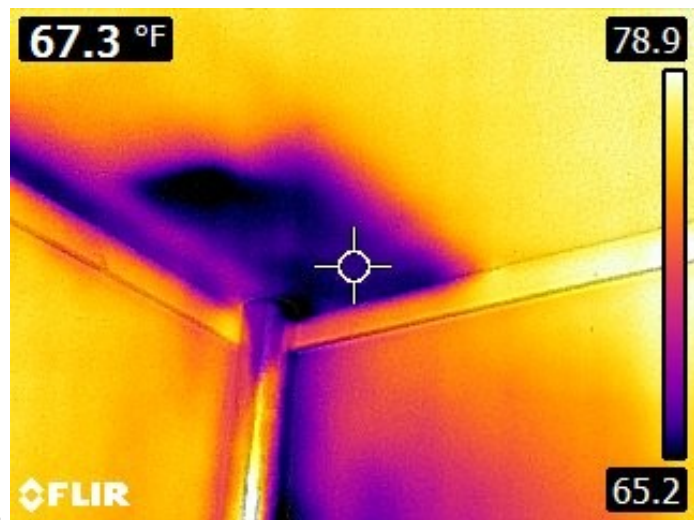
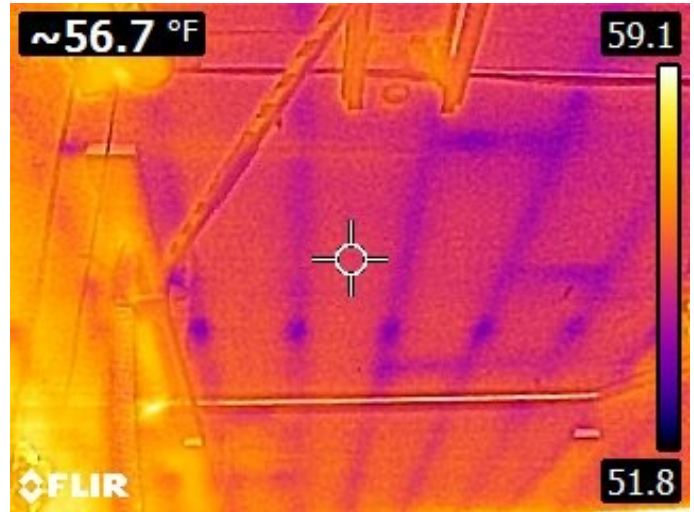


Unless mistaken, the photos below are of a recent upgrade between the two structures and steel beams are within the thermal boundary. Any steel on exterior walls should also be spray with a minimum 2" closed cell foam

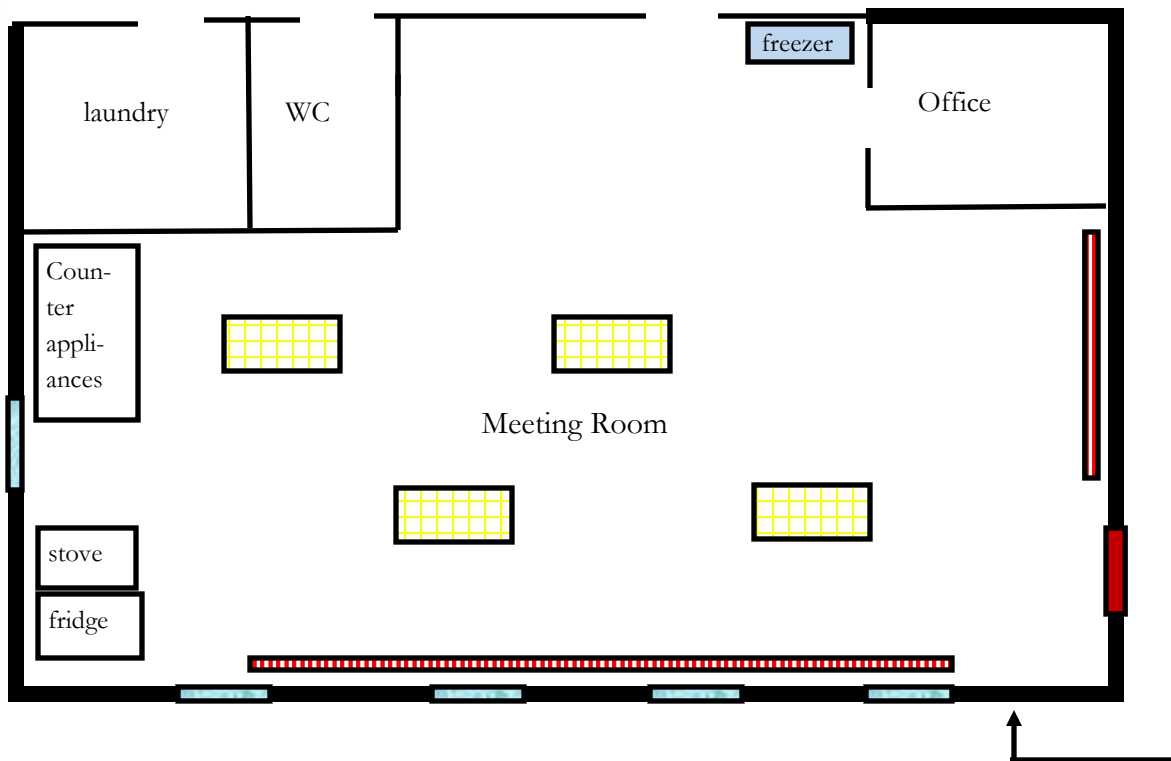
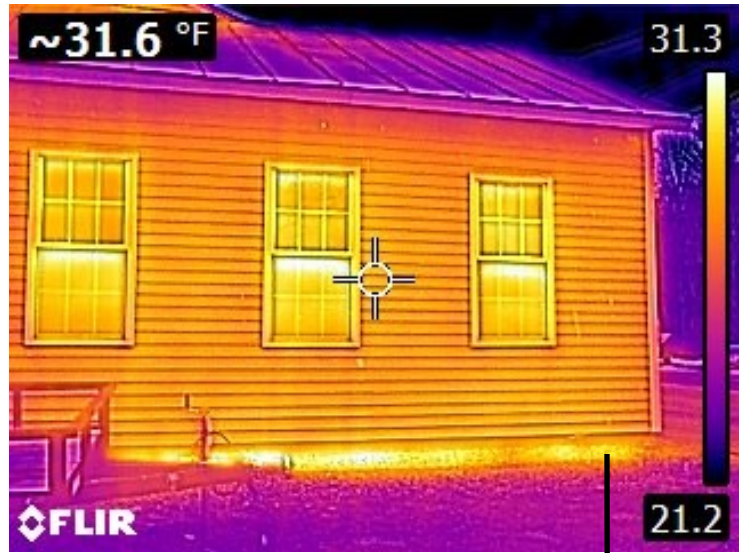


Garage Bay Ceiling

Insulation in between ceiling joists appears well installed with only a few voids (as shown). However thermal bridging at framing impacts total ceiling thermal performance and can result in “ghosting” as dirt particles adhere to cooler, even slightly condensing surfaces. Without access above the ceiling, total conditions could not be assessed.



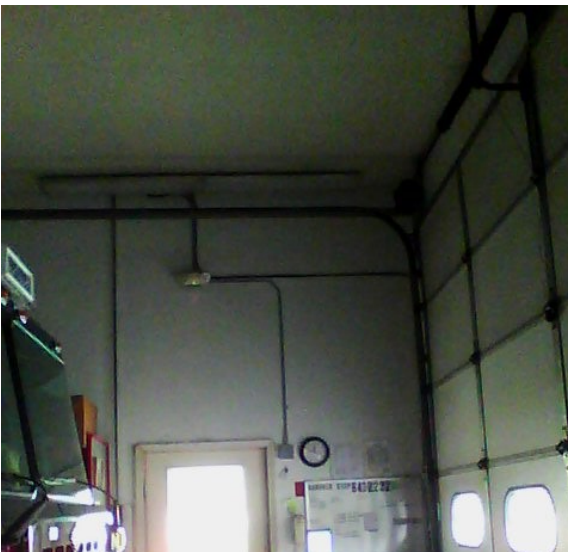
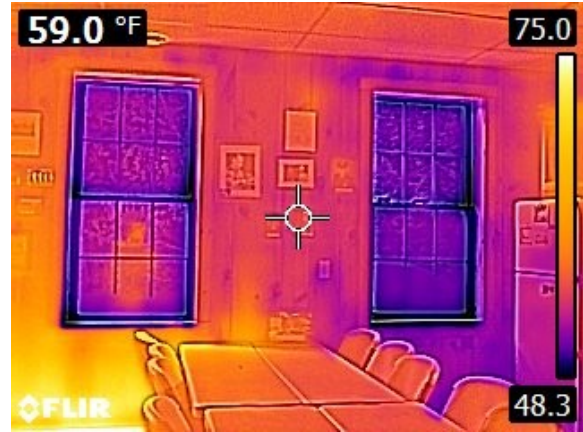
Foundation Losses



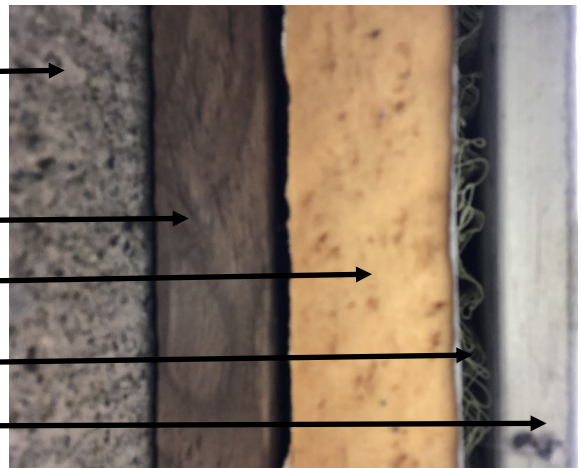
Walls

The original structure—consisting of the three garage bays—is believed to have been constructed in the 1950’s, with 2x4 wall framing. The 24’ x 30’ meeting room was added within the last 20-30 years, using 2x6 exterior framing.

All walls appear to have fiberglass batts in stud cavities. At some point when re-siding with cement boards, one inch foil faced polyisocyanurate was installed over sheathing, followed by Homeslicker for a drainage plane. The additional rigid foam layer significantly reduces thermal bridging and improves thermal performance for both wall eras.



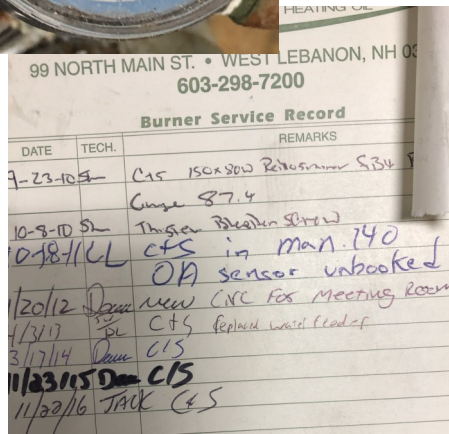
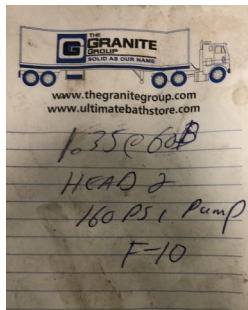
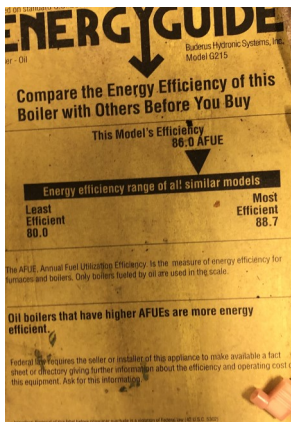
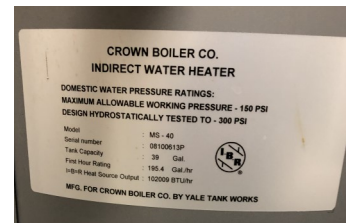
- Concrete at foundation →
- (Or wood framing above)
- Exterior sheathing →
- 1” foil faced polyiso →
- Homeslicker →
- Clapboard →



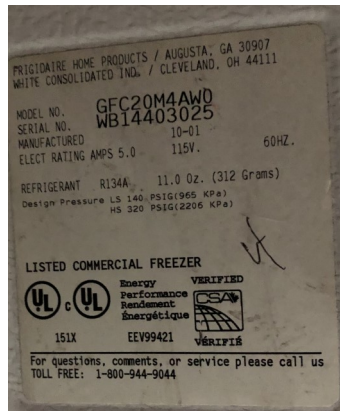
Heating Equipment

Buderus Model G215/5 with Logamatic Control

Serial # 05178454-00-8205-2623



Appliances



Freezer manufactured in 2001 and is likely the largest load of all appliances. Keep filled with bags of ice. If this is frequently less than half full, consider replacing with two smaller Energy Star chest freezers, and turn one off when empty.

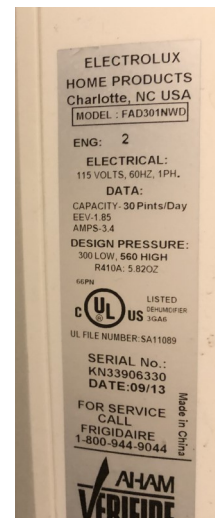
Fridge looks fairly new and based on the second letter of the Serial number, it was likely made in 2017—but if 2005, consider replacing with an Energy Star model.



Other than refrigeration, all other appliances and office equipment appear modest—necessary for operations—and used to infrequently to replace.



When replacing, consider a larger, 70 pint unit, which is typically more efficient than smaller, 30 pint units.



*Meriden Fire Station Existing Conditions
HVAC Load Calculations*

for

Plainfield and Liberty Utilities



RHVAC RESIDENTIAL
HVAC LOADS

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Report

General Project Information

Project Title: Meriden Fire Station Existing Conditions
 Project Date: Tuesday, March 24, 2020
 Client Name: Liberty and Town of Plainfield
 Company Name: Margaret Dillon
 Company Representative: mdillon@myfairpoint.net
 Company E-Mail Address:

Design Data

Reference City: Lebanon, New Hampshire
 Building Orientation: Front door faces SE
 Daily Temperature Range: Medium
 Latitude: 43 Degrees
 Elevation: 906 ft.
 Altitude Factor: 0.968

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	n/a	n/a	61	n/a
Summer:	86	69	43%	50%	75	16

Check Figures

Total Building Supply CFM: 0 CFM Per Square ft.: 0.000 *
 Square ft. of Room Area: 2,728 Square ft. Per Ton: 0 **
 Volume (ft³): 33,000***

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 52,079 Btuh 52.079 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.
 Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
 All computed results are estimates as building use and weather may vary.
 Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Miscellaneous Report

System 1 Buderus G215/5 Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	80%	n/a	61	n/a
Summer:	86	69	43%	50%	75	15.73

Duct Sizing Inputs

	Main Trunk	Runouts
Calculate:	No	No
Use Schedule:	Yes	Yes
Roughness Factor:	0.00300	0.01000
Pressure Drop:	0.1000 in.wg./100 ft.	0.1000 in.wg./100 ft.
Minimum Velocity:	0 ft./min	0 ft./min
Maximum Velocity:	900 ft./min	750 ft./min
Minimum Height:	0 in.	0 in.
Maximum Height:	0 in.	0 in.

Outside Air Data

	Winter	Summer
Infiltration Specified:	0.507 AC/hr (rm specified) 279 CFM	0.250 AC/hr 138 CFM
Infiltration Actual:	0.507 AC/hr (rm specified)	0.250 AC/hr
Building Volume:	X 33,000* Cu.ft. 16,740 Cu.ft./hr X 0.0167	X 33,000* Cu.ft. 8,250 Cu.ft./hr X 0.0167
Total Building Infiltration:	279 CFM	138 CFM
Total Building Ventilation:	0 CFM	0 CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 11.71 = (1.10 X 0.968 X 11.00 Summer Temp. Difference)
 Infiltration & Ventilation Latent Gain Multiplier: 10.35 = (0.68 X 0.968 X 15.73 Grains Difference)
 Infiltration & Ventilation Sensible Loss Multiplier: 68.13 = (1.10 X 0.968 X 64.00 Winter Temp. Difference)
 Winter Infiltration Specified: 0.507 AC/hr (rm specified) (279 CFM), Construction: Semi-Loose
 Summer Infiltration Specified: 0.250 AC/hr (138 CFM), Construction: Semi-Loose



Load Preview Report

Scope	Net Ton	ft. ² /Ton	Area	Sen Gain	Lat Gain	Net Gain	Sen Loss	Sys Htg CFM	Sys Clg CFM	Sys Act CFM	Duct Size
Building	0.00	0	2,728	0	0	0	52,079	699	0	0	
System 1	0.00	0	2,728	0	0	0	52,079	699	0	0	0*
HW Piping							3,600				
Zone 1			2,728	0	0	0	48,479	699	0	699	
1-Meeting Room			616	0	0	0	13,231	191	0	191	2--0*
2-Bays			2,112	0	0	0	35,248	508	0	508	5--0*



Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Meriden: Glazing-DP wood DH, U-value 0.37, SHGC 0.35	103.5	2,451	0	0	0
11G: Door-Wood - Panel, U-value 0.54	38.1	1,316	0	0	0
Overhead: Door-Overhead in front of Double, U-value 0.1	504	3,226	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Poly rigid, U-value 0.042	612.7	1,647	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Poly rigid, U-value 0.125	112.5	900	0	0	0
12B-6sw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, R-6 board insulation, siding finish, wood studs, U-value 0.064	1487.7	6,093	0	0	0
16B-15: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-15 insulation, U-value 0.061	616	2,405	0	0	0
16B-19: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-19 insulation, U-value 0.049	2112	6,623	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.989	76	4,811	0	0	0
Subtotals for structure:		29,472	0	0	0
People:	0		0	0	0
Equipment:			0	0	0
Lighting:	0			0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 279, Summer CFM: 138		19,007	0	0	0
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 50 ft. Total:		3,600	0	0	0
Total Building Load Totals:		52,079	0	0	0

Check Figures

Total Building Supply CFM:	0	CFM Per Square ft.:	0.000 *
Square ft. of Room Area:	2,728	Square ft. Per Ton:	0 **
Volume (ft³):	33,000***		

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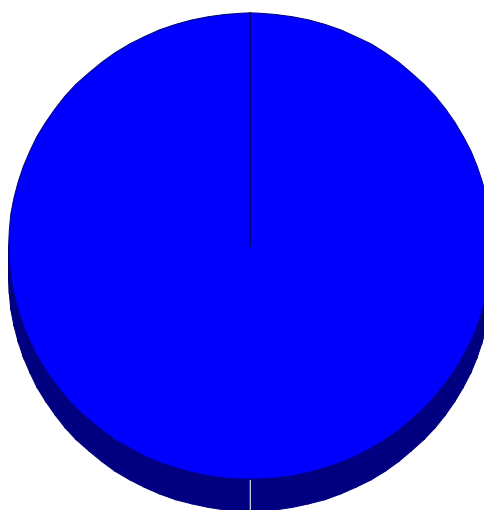
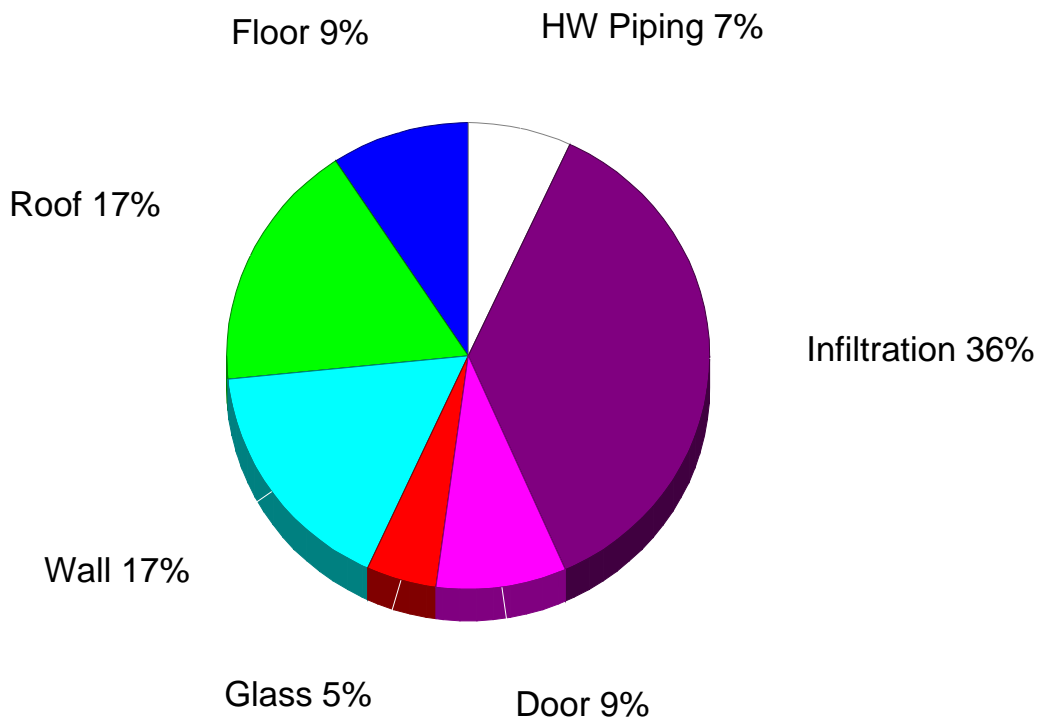
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Building Pie Chart



100.0%



Detailed Room Loads - Room 1 - Meeting Room

General

Calculation Mode:	Htg. only	Occurrences:	1
Room Length:	n/a	System Number:	1
Room Width:	n/a	Zone Number:	1
Area:	616.0 sq.ft.	Supply Air:	191 CFM
Ceiling Height:	9.0 ft.	Supply Air Changes:	2.1 AC/hr
Volume:	5,544** cu.ft.	Req. Vent. Clg:	0 CFM
Number of Registers:	2	Actual Winter Vent.:	0 CFM
Runout Air:	0 CFM	Percent of Supply.:	0 %
		Actual Summer Vent.:	0 CFM
		Percent of Supply:	0 %
		Actual Winter Infil.:	54 CFM
		Actual Summer Infil.:	0 CFM

**Indicated volume is based on custom building volume.

Item Description	Area Quantity	-U- Value	Htg HTM	Sen Loss	Clg HTM	Lat Gain	Sen Gain
SE-Wall-Meriden Meeting 22 X 9	165.5	0.042	2.7	445	0.0	0	0
SW-Wall-Meriden Meeting 28 X 9	193.8	0.042	2.7	521	0.0	0	0
NW-Wall-Meriden Meeting 22 X 9	183.4	0.042	2.7	493	0.0	0	0
NE-Wall-Meriden Meeting 7 X 10	70	0.042	2.7	188	0.0	0	0
N -Wall-Meriden Meeting 75 X 1.5	112.5	0.125	8.0	900	0.0	0	0
SE-Door-11G 2.8 X 6.8	19	0.540	34.6	658	0.0	0	0
SE-Gls-Meriden shgc-0.35 0%S	13.4	0.370	23.7	318	0.0	0	0
SW-Gls-Meriden shgc-0.35 0%S (4)	58.2	0.370	23.7	1,380	0.0	0	0
NW-Gls-Meriden shgc-0.35 0%S	14.6	0.370	23.7	345	0.0	0	0
UP-Ceil-16B-15 616 X 1	616	0.061	3.9	2,405	0.0	0	0
Floor-22A-pl 30 ft..Per.	30	0.989	63.3	1,899	0.0	0	0
Subtotals for Structure:				9,552		0	0
Infil.: Win.: 54.0, Sum.: 0.0	831		4.430	3,679	0.000	0	0
Room Totals:				13,231		0	0



Detailed Room Loads - Room 2 - Bays

General

Calculation Mode:	Htg. only	Occurrences:	1
Room Length:	n/a	System Number:	1
Room Width:	n/a	Zone Number:	1
Area:	2,112.0 sq.ft.	Supply Air:	508 CFM
Ceiling Height:	13.0 ft.	Supply Air Changes:	1.1 AC/hr
Volume:	27,456** cu.ft.	Req. Vent. Clg:	0 CFM
Number of Registers:	5	Actual Winter Vent.:	0 CFM
Runout Air:	0 CFM	Percent of Supply.:	0 %
		Actual Summer Vent.:	0 CFM
		Percent of Supply:	0 %
		Actual Winter Infil.:	225 CFM
		Actual Summer Infil.:	0 CFM

**Indicated volume is based on custom building volume.

Item Description	Area Quantity	-U- Value	Htg HTM	Sen Loss	Clg HTM	Lat Gain	Sen Gain
SE-Wall-12B-6sw 46 X 13	76.7	0.064	4.1	314	0.0	0	0
NE-Wall-12B-6sw 44 X 13	553	0.064	4.1	2,265	0.0	0	0
NW-Wall-12B-6sw 46 X 13	598	0.064	4.1	2,449	0.0	0	0
N -Wall-12B-6sw 20 X 13	260	0.064	4.1	1,065	0.0	0	0
NE-Door-11G 2.8 X 6.8	19	0.540	34.6	658	0.0	0	0
SE-Door-Overhead 36 X 14	504	0.100	6.4	3,226	0.0	0	0
SE-Gls-Meriden shgc-0.35 0%S (12)	17.3	0.370	23.7	408	0.0	0	0
UP-Ceil-16B-19 2112 X 1	2112	0.049	3.1	6,623	0.0	0	0
Floor-22A-pl 46 ft..Per.	46	0.989	63.3	2,912	0.0	0	0
Subtotals for Structure:				19,920		0	0
Infil.: Win.: 225.0, Sum.: 0.0	2,028		7.558	15,328	0.000	0	0
Room Totals:				35,248		0	0



System 1 Room Load Summary

No	Room Name	Area SF	Htg Sens Btuh	Htg Rad Len	Run Duct Size	Run Duct Vel	Clg Sens Btuh	Clg Lat Btuh	Clg Nom CFM	Air Sys CFM
---Zone 1---										
1	Meeting Room	616	13,231	18.5	2-0	0	0	0	0	191
2	Bays	2,112	35,248	49.2	5-0	0	0	0	0	508
	HW Piping		3,600							
	System 1 total	2,728	52,079	72.6			0	0	0	0

Cooling System Summary

	Cooling Tons	Sensible/Latent Split	Sensible Btuh	Latent Btuh	Total Btuh
Net Required:	0.00	0% / 0%	0	0	0

Equipment Data

	Heating System	Cooling System
Type:	Fuel Oil Boiler	Standard Air Conditioner
Model:	G215/5	
Indoor Model:		
Brand:	Buderus	
Efficiency:	86 AFUE	0 SEER
Sound:	0	0
Capacity:	160,000 Btuh	0 Btuh
Sensible Capacity:	n/a	0 Btuh
Latent Capacity:	n/a	0 Btuh

*Meriden Fire Station After ESM 1
HVAC Load Calculations*

for

Liberty Utilities and Town of Plainfield



RHVAC RESIDENTIAL
HVAC LOADS

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Report

General Project Information

Project Title: Meriden Fire Station After ESM 1
 Project Date: Tuesday, March 24, 2020
 Client Name: Plainfield and Liberty
 Company Name: Margaret Dillon
 Company Representative:
 Company E-Mail Address: mdillon@myfairpoint.net

Design Data

Reference City: Lebanon, New Hampshire
 Building Orientation: Front door faces SE
 Daily Temperature Range: Medium
 Latitude: 43 Degrees
 Elevation: 906 ft.
 Altitude Factor: 0.968

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	n/a	n/a	61	n/a
Summer:	86	69	43%	50%	75	16

Check Figures

Total Building Supply CFM: 0 CFM Per Square ft.: 0.000 *
 Square ft. of Room Area: 2,728 Square ft. Per Ton: 0 **
 Volume (ft³): 33,000***

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 46,970 Btuh 46.970 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.
 Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
 All computed results are estimates as building use and weather may vary.
 Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Miscellaneous Report

System 1 Buderus G215/5 Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	80%	n/a	61	n/a
Summer:	86	69	43%	50%	75	15.73

Duct Sizing Inputs

	Main Trunk	Runouts
Calculate:	No	No
Use Schedule:	Yes	Yes
Roughness Factor:	0.00300	0.01000
Pressure Drop:	0.1000 in.wg./100 ft.	0.1000 in.wg./100 ft.
Minimum Velocity:	0 ft./min	0 ft./min
Maximum Velocity:	900 ft./min	750 ft./min
Minimum Height:	0 in.	0 in.
Maximum Height:	0 in.	0 in.

Outside Air Data

	Winter	Summer
Infiltration Specified:	0.490 AC/hr 270 CFM	0.250 AC/hr 138 CFM
Infiltration Actual:	0.490 AC/hr	0.250 AC/hr
Building Volume:	X 33,000* Cu.ft. 16,170 Cu.ft./hr	X 33,000* Cu.ft. 8,250 Cu.ft./hr
	X 0.0167	X 0.0167
Total Building Infiltration:	270 CFM	138 CFM
Total Building Ventilation:	0 CFM	0 CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 11.71 = (1.10 X 0.968 X 11.00 Summer Temp. Difference)
 Infiltration & Ventilation Latent Gain Multiplier: 10.35 = (0.68 X 0.968 X 15.73 Grains Difference)
 Infiltration & Ventilation Sensible Loss Multiplier: 68.13 = (1.10 X 0.968 X 64.00 Winter Temp. Difference)
 Winter Infiltration Specified: 0.490 AC/hr (270 CFM), Construction: Semi-Loose
 Summer Infiltration Specified: 0.250 AC/hr (138 CFM), Construction: Semi-Loose



Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Meriden: Glazing-DP wood DH, U-value 0.37, SHGC 0.35	103.5	2,451	0	0	0
11G: Door-Wood - Panel, U-value 0.54	38.1	1,316	0	0	0
Overhead: Door-Overhead in front of Double, U-value 0.1	504	3,226	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Polyi rigid, U-value 0.042	612.7	1,647	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Polyi rigid, U-value 0.125	112.5	900	0	0	0
12B-6sw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, R-6 board insulation, siding finish, wood studs, U-value 0.064	1487.7	6,093	0	0	0
16B-15: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-15 insulation, U-value 0.061	616	2,405	0	0	0
16B-19: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-19 insulation, U-value 0.049	2112	6,623	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.989	76	4,811	0	0	0
Subtotals for structure:		29,472	0	0	0
People:	0		0	0	0
Equipment:			0	0	0
Lighting:	0			0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 270, Summer CFM: 138		13,898	0	0	0
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 50 ft. Total:		3,600	0	0	0
Total Building Load Totals:		46,970	0	0	0

Check Figures

Total Building Supply CFM:	0	CFM Per Square ft.:	0.000 *
Square ft. of Room Area:	2,728	Square ft. Per Ton:	0 **
Volume (ft³):	33,000***		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 46,970 Btuh 46.970 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

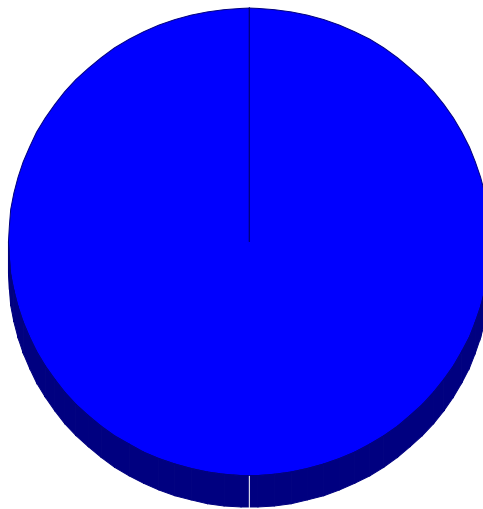
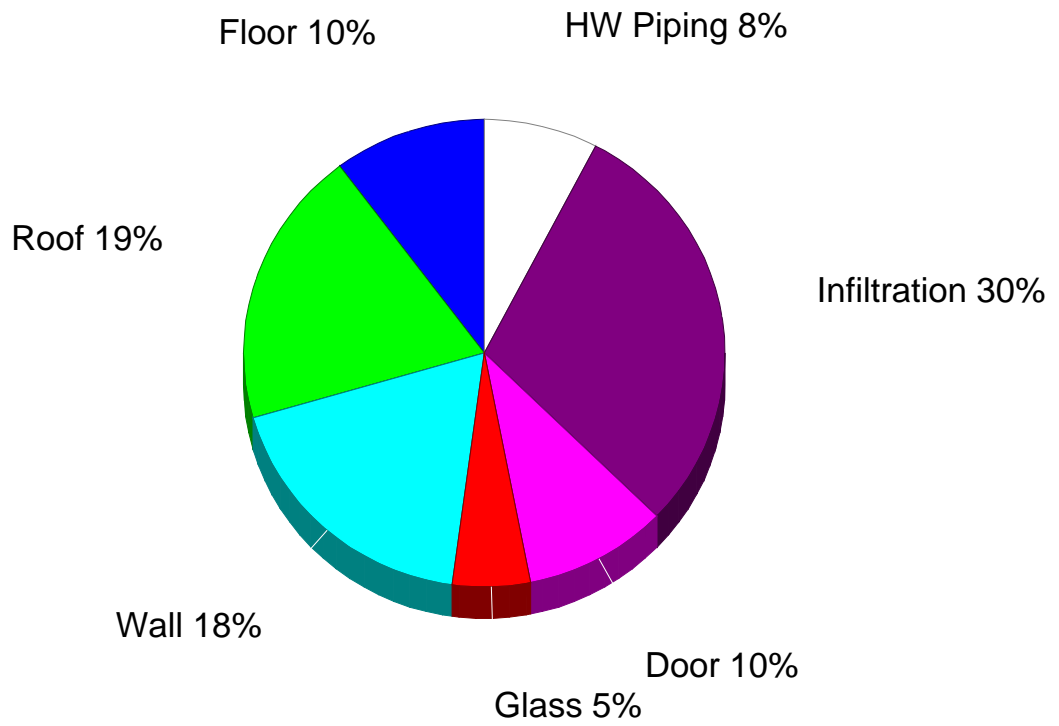
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Building Pie Chart



100.0%

*Meriden Fire Station After ESM 2
HVAC Load Calculations*

for

Liberty Utilities and Town of Plainfield



RHVAC RESIDENTIAL
HVAC LOADS

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Report

General Project Information Meriden Fire Station After ESM 2

Project Title: Tuesday, March 24, 2020
 Project Date: Liberty Utilities & Town of Plainfield
 Client Name: S.E.E.D.S.
 Company Name: Margaret Dillon
 Company Representative:
 Company E-Mail Address: mdillon@myfairpoint.net

Design Data

Reference City: Lebanon, New Hampshire
 Building Orientation: Front door faces SE
 Daily Temperature Range: Medium
 Latitude: 43 Degrees
 Elevation: 906 ft.
 Altitude Factor: 0.968

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	n/a	n/a	61	n/a
Summer:	86	69	43%	50%	75	16

Check Figures

Total Building Supply CFM: 0 CFM Per Square ft.: 0.000 *
 Square ft. of Room Area: 2,728 Square ft. Per Ton: 0 **
 Volume (ft³): 33,000***

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 43,847 Btuh 43.847 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Miscellaneous Report

System 1 Buderus G215/5 Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	80%	n/a	61	n/a
Summer:	86	69	43%	50%	75	15.73

Duct Sizing Inputs

	Main Trunk	Runouts
Calculate:	No	No
Use Schedule:	Yes	Yes
Roughness Factor:	0.00300	0.01000
Pressure Drop:	0.1000 in.wg./100 ft.	0.1000 in.wg./100 ft.
Minimum Velocity:	0 ft./min	0 ft./min
Maximum Velocity:	900 ft./min	750 ft./min
Minimum Height:	0 in.	0 in.
Maximum Height:	0 in.	0 in.

Outside Air Data

	Winter	Summer
Infiltration Specified:	0.490 AC/hr 270 CFM	0.250 AC/hr 138 CFM
Infiltration Actual:	0.490 AC/hr	0.250 AC/hr
Building Volume:	X 33,000* Cu.ft. 16,170 Cu.ft./hr	X 33,000* Cu.ft. 8,250 Cu.ft./hr
	X 0.0167	X 0.0167
Total Building Infiltration:	270 CFM	138 CFM
Total Building Ventilation:	0 CFM	0 CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 11.71 = (1.10 X 0.968 X 11.00 Summer Temp. Difference)
 Infiltration & Ventilation Latent Gain Multiplier: 10.35 = (0.68 X 0.968 X 15.73 Grains Difference)
 Infiltration & Ventilation Sensible Loss Multiplier: 68.13 = (1.10 X 0.968 X 64.00 Winter Temp. Difference)
 Winter Infiltration Specified: 0.490 AC/hr (270 CFM), Construction: Semi-Loose
 Summer Infiltration Specified: 0.250 AC/hr (138 CFM), Construction: Semi-Loose



Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Meriden: Glazing-DP wood DH, U-value 0.37, SHGC 0.35	103.5	2,451	0	0	0
11G: Door-Wood - Panel, U-value 0.54	38.1	1,316	0	0	0
Overhead: Door-Overhead in front of Double, U-value 0.1	504	3,226	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Poly rigid, U-value 0.042	725.2	1,949	0	0	0
12B-6sw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, R-6 board insulation, siding finish, wood studs, U-value 0.064	1487.7	6,093	0	0	0
16B-15: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-15 insulation, U-value 0.061	616	2,405	0	0	0
16B-19: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-19 insulation, U-value 0.049	2112	6,623	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.989	76	4,811	0	0	0
Subtotals for structure:		28,874	0	0	0
People:	0		0	0	0
Equipment:			0	0	0
Lighting:	0			0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 270, Summer CFM: 138		13,898	0	0	0
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 50 ft. Total:		1,075	0	0	0
Total Building Load Totals:		43,847	0	0	0

Check Figures

Total Building Supply CFM:	0	CFM Per Square ft.:	0.000 *
Square ft. of Room Area:	2,728	Square ft. Per Ton:	0 **
Volume (ft ³):	33,000***		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 43,847 Btuh 43.847 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

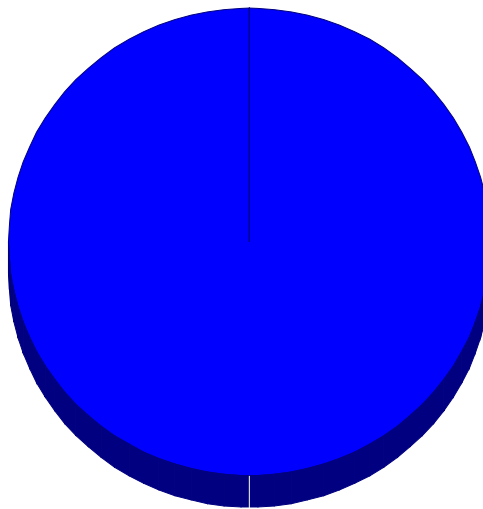
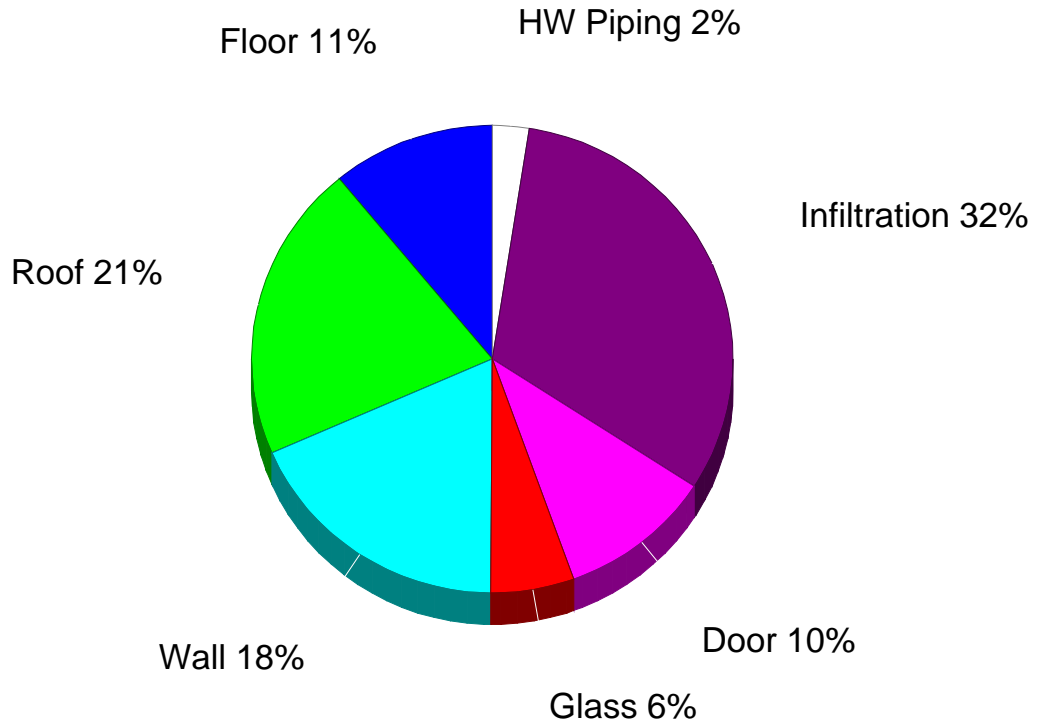
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Building Pie Chart



100.0%

*Meriden Fire Station After ESM 3
HVAC Load Calculations*

for

Liberty Utilities & Town of Plainfield



RHVAC RESIDENTIAL
HVAC LOADS

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Report

General Project Information

Project Title: Meriden Fire Station After ESM
 Project Date: 3 Tuesday, March 24, 2020
 Client Name: Liberty & Town of Plainfield
 Company Name: S.E.E.D.S.
 Company Representative: Margaret Dillon
 Company E-Mail Address: mdillon@myfairpoint.net

Design Data

Reference City: Lebanon, New Hampshire
 Building Orientation: Front door faces SE
 Daily Temperature Range:
 Latitude: 43 Degrees
 Elevation: 906 ft.
 Altitude Factor: 0.968

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	n/a	n/a	61	n/a
Summer:	86	69	43%	50%	75	16

Check Figures

Total Building Supply CFM: 0 CFM Per Square ft.: 0.000 *
 Square ft. of Room Area: 2,728 Square ft. Per Ton: 0 **
 Volume (ft³): 33,000***

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 39,927 Btuh 39.927 MBH

Notes

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Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Miscellaneous Report

System 1 Buderus G215/5 Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	80%	n/a	61	n/a
Summer:	86	69	43%	50%	75	15.73

Duct Sizing Inputs

	Main Trunk	Runouts
Calculate:	No	No
Use Schedule:	Yes	Yes
Roughness Factor:	0.00300	0.01000
Pressure Drop:	0.1000 in.wg./100 ft.	0.1000 in.wg./100 ft.
Minimum Velocity:	0 ft./min	0 ft./min
Maximum Velocity:	900 ft./min	750 ft./min
Minimum Height:	0 in.	0 in.
Maximum Height:	0 in.	0 in.

Outside Air Data

	Winter	Summer
Infiltration Specified:	0.490 AC/hr 270 CFM	0.250 AC/hr 138 CFM
Infiltration Actual:	0.490 AC/hr	0.250 AC/hr
Building Volume:	X 33,000* Cu.ft. 16,170 Cu.ft./hr	X 33,000* Cu.ft. 8,250 Cu.ft./hr
	X 0.0167	X 0.0167
Total Building Infiltration:	270 CFM	138 CFM
Total Building Ventilation:	0 CFM	0 CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 11.71 = (1.10 X 0.968 X 11.00 Summer Temp. Difference)
 Infiltration & Ventilation Latent Gain Multiplier: 10.35 = (0.68 X 0.968 X 15.73 Grains Difference)
 Infiltration & Ventilation Sensible Loss Multiplier: 68.13 = (1.10 X 0.968 X 64.00 Winter Temp. Difference)
 Winter Infiltration Specified: 0.490 AC/hr (270 CFM), Construction: Semi-Loose
 Summer Infiltration Specified: 0.250 AC/hr (138 CFM), Construction: Semi-Loose



Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Meriden: Glazing-DP wood DH, U-value 0.37, SHGC 0.35	103.5	2,451	0	0	0
11G: Door-Wood - Panel, U-value 0.54	38.1	1,316	0	0	0
Overhead: Door-Overhead in front of Double, U-value 0.1	504	3,226	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Poly rigid, U-value 0.042	725.2	1,949	0	0	0
12B-6sw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, R-6 board insulation, siding finish, wood studs, U-value 0.064	1487.7	6,093	0	0	0
16B-15: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-15 insulation, U-value 0.061	616	2,405	0	0	0
16B-50: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-50 insulation, U-value 0.02	2112	2,703	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.989	76	4,811	0	0	0
Subtotals for structure:		24,954	0	0	0
People:	0		0	0	0
Equipment:			0	0	0
Lighting:	0			0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 270, Summer CFM: 138		13,898	0	0	0
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 50 ft. Total:		1,075	0	0	0
Total Building Load Totals:		39,927	0	0	0

Check Figures

Total Building Supply CFM:	0	CFM Per Square ft.:	0.000 *
Square ft. of Room Area:	2,728	Square ft. Per Ton:	0 **
Volume (ft ³):	33,000***		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 39,927 Btuh 39.927 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

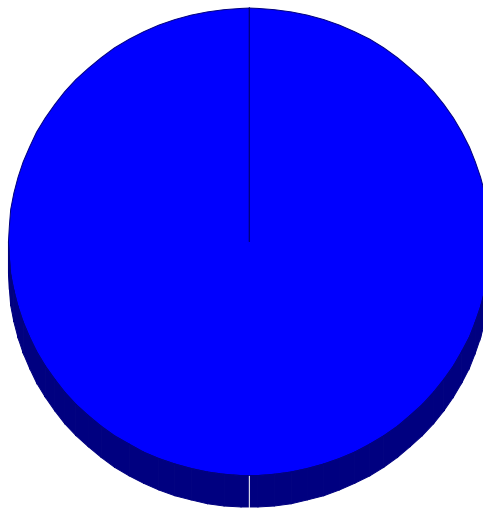
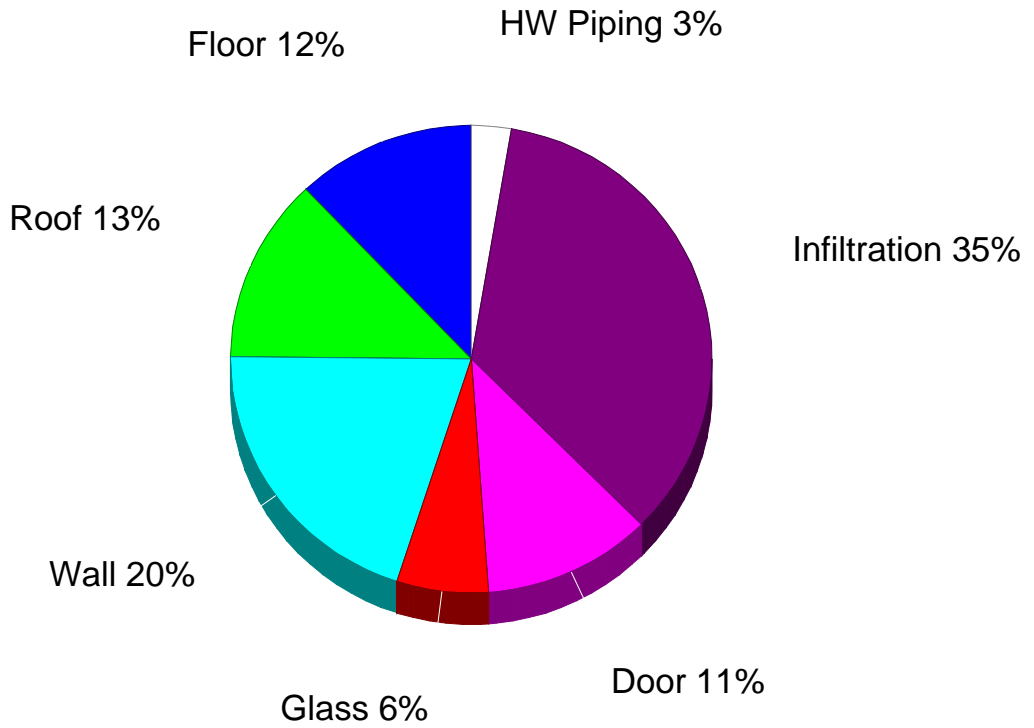
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Building Pie Chart



100.0%

*Meriden Fire Station After ESM 4
HVAC Load Calculations*

for

Liberty Utilities & Town of Plainfield



RHVAC RESIDENTIAL
HVAC LOADS

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Report

General Project Information

Project Title: Meriden Fire Station After ESM 4
 Project Date: Tuesday, March 24, 2020
 Client Name: Liberty Utilities & Town of Plainfield
 Company Name: S.E.E.D.S.
 Company Representative: Margaret Dillon
 Company E-Mail Address: mdillon@myfairpoint.net

Design Data

Reference City: Lebanon, New Hampshire
 Building Orientation: Front door faces SE
 Daily Temperature Range: Medium
 Latitude: 43 Degrees
 Elevation: 906 ft.
 Altitude Factor: 0.968

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	n/a	n/a	61	n/a
Summer:	86	69	43%	50%	75	16

Check Figures

Total Building Supply CFM: 0 CFM Per Square ft.: 0.000 *
 Square ft. of Room Area: 2,728 Square ft. Per Ton: 0 **
 Volume (ft³): 33,000***

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 38,310 Btuh 38.310 MBH

Notes

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 Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.
 All computed results are estimates as building use and weather may vary.
 Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Miscellaneous Report

System 1 Buderus G215/5 Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	80%	n/a	61	n/a
Summer:	86	69	43%	50%	75	15.73

Duct Sizing Inputs

	Main Trunk	Runouts
Calculate:	No	No
Use Schedule:	Yes	Yes
Roughness Factor:	0.00300	0.01000
Pressure Drop:	0.1000 in.wg./100 ft.	0.1000 in.wg./100 ft.
Minimum Velocity:	0 ft./min	0 ft./min
Maximum Velocity:	900 ft./min	750 ft./min
Minimum Height:	0 in.	0 in.
Maximum Height:	0 in.	0 in.

Outside Air Data

	Winter	Summer
Infiltration Specified:	0.490 AC/hr 270 CFM	0.250 AC/hr 138 CFM
Infiltration Actual:	0.490 AC/hr	0.250 AC/hr
Building Volume:	X 33,000* Cu.ft. 16,170 Cu.ft./hr	X 33,000* Cu.ft. 8,250 Cu.ft./hr
	X 0.0167	X 0.0167
Total Building Infiltration:	270 CFM	138 CFM
Total Building Ventilation:	0 CFM	0 CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 11.71 = (1.10 X 0.968 X 11.00 Summer Temp. Difference)
 Infiltration & Ventilation Latent Gain Multiplier: 10.35 = (0.68 X 0.968 X 15.73 Grains Difference)
 Infiltration & Ventilation Sensible Loss Multiplier: 68.13 = (1.10 X 0.968 X 64.00 Winter Temp. Difference)
 Winter Infiltration Specified: 0.490 AC/hr (270 CFM), Construction: Semi-Loose
 Summer Infiltration Specified: 0.250 AC/hr (138 CFM), Construction: Semi-Loose



Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Meriden: Glazing-DP wood DH, U-value 0.37, SHGC 0.35	103.5	2,451	0	0	0
11G: Door-Wood - Panel, U-value 0.54	38.1	1,316	0	0	0
Overhead: Door-Overhead in front of Double, U-value 0.1	504	3,226	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Poly rigid, U-value 0.042	725.2	1,949	0	0	0
12B-6sw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, R-6 board insulation, siding finish, wood studs, U-value 0.064	1487.7	6,093	0	0	0
16B-50: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-50 insulation, U-value 0.02	2728	3,491	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.989	76	4,811	0	0	0
Subtotals for structure:		23,337	0	0	0
People:	0		0	0	0
Equipment:			0	0	0
Lighting:	0		0	0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 270, Summer CFM: 138		13,898	0	0	0
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 50 ft. Total:		1,075	0	0	0
Total Building Load Totals:		38,310	0	0	0

Check Figures

Total Building Supply CFM:	0	CFM Per Square ft.:	0.000 *
Square ft. of Room Area:	2,728	Square ft. Per Ton:	0 **
Volume (ft³):	33,000***		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 38,310 Btuh 38.310 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

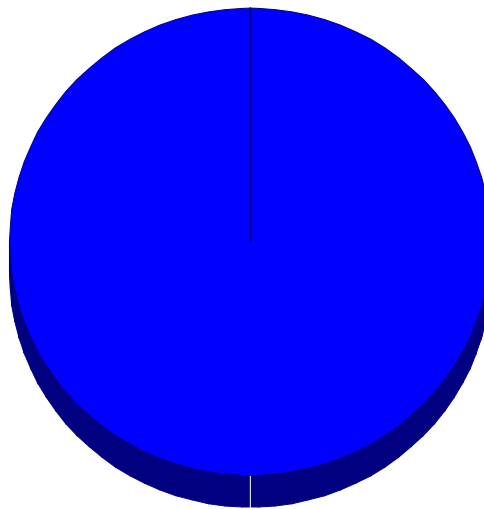
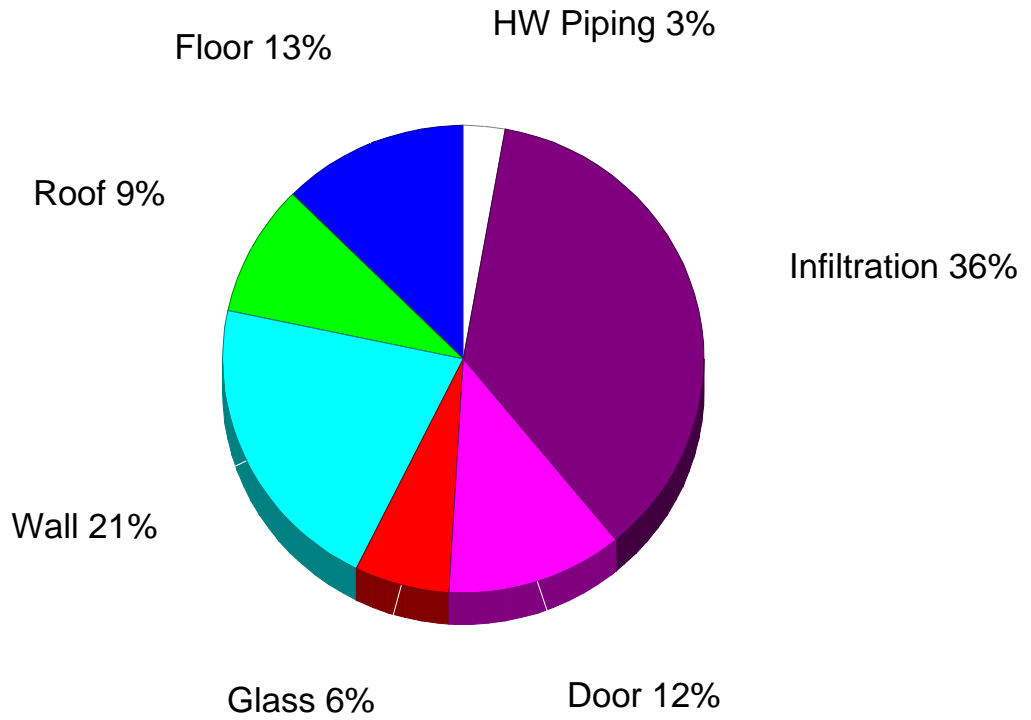
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Building Pie Chart



100.0%

*Meriden Fire Station After ESM 5
HVAC Load Calculations*

for

Liberty Utilities & Town of Plainfield



RHVAC RESIDENTIAL
HVAC LOADS

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Report

General Project Information

Project Title: Meriden Fire Station After ESM 5
 Project Date: Tuesday, March 24, 2020 Liberty
 Client Name: Utilities & Town of Plainfield
 Company Name: S.E.E.D.S.
 Company Representative: Margaret Dillon
 Company E-Mail Address: mdillon@myfairpoint.net

Design Data

Reference City: Lebanon, New Hampshire
 Building Orientation: Front door faces SE
 Daily Temperature Range: Medium
 Latitude: 43 Degrees
 Elevation: 906 ft.
 Altitude Factor: 0.968

	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	n/a	n/a	61	n/a
Summer:	86	69	43%	50%	75	16

Check Figures

Total Building Supply CFM: 0 CFM Per Square ft.: 0.000 *
 Square ft. of Room Area: 2,728 Square ft. Per Ton: 0 **
 Volume (ft³): 33,000***

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 36,584 Btuh 36.584 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Miscellaneous Report

System 1 Buderus G215/5 Input Data	Outdoor Dry Bulb	Outdoor Wet Bulb	Outdoor Rel.Hum	Indoor Rel.Hum	Indoor Dry Bulb	Grains Difference
Winter:	-3	-3.6	80%	n/a	61	n/a
Summer:	86	69	43%	50%	75	15.73

Duct Sizing Inputs

	Main Trunk	Runouts
Calculate:	No	No
Use Schedule:	Yes	Yes
Roughness Factor:	0.00300	0.01000
Pressure Drop:	0.1000 in.wg./100 ft.	0.1000 in.wg./100 ft.
Minimum Velocity:	0 ft./min	0 ft./min
Maximum Velocity:	900 ft./min	750 ft./min
Minimum Height:	0 in.	0 in.
Maximum Height:	0 in.	0 in.

Outside Air Data

	Winter	Summer
Infiltration Specified:	0.490 AC/hr 270 CFM	0.250 AC/hr 138 CFM
Infiltration Actual:	0.490 AC/hr	0.250 AC/hr
Building Volume:	X 33,000* Cu.ft. 16,170 Cu.ft./hr	X 33,000* Cu.ft. 8,250 Cu.ft./hr
	X 0.0167	X 0.0167
Total Building Infiltration:	270 CFM	138 CFM
Total Building Ventilation:	0 CFM	0 CFM

*Indicated volume is based on custom building volume.

---System 1---

Infiltration & Ventilation Sensible Gain Multiplier: 11.71 = (1.10 X 0.968 X 11.00 Summer Temp. Difference)
 Infiltration & Ventilation Latent Gain Multiplier: 10.35 = (0.68 X 0.968 X 15.73 Grains Difference)
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 Winter Infiltration Specified: 0.490 AC/hr (270 CFM), Construction: Semi-Loose
 Summer Infiltration Specified: 0.250 AC/hr (138 CFM), Construction: Semi-Loose



Total Building Summary Loads

Component Description	Area Quan	Sen Loss	Lat Gain	Sen Gain	Total Gain
Meriden: Glazing-DP wood DH, U-value 0.37, SHGC 0.35	103.5	2,451	0	0	0
11G: Door-Wood - Panel, U-value 0.54	38.1	1,316	0	0	0
Overhead: Door-Overhead in front of Double, U-value 0.1	504	3,226	0	0	0
Meriden Meeting: Wall-Frame, Custom, 2x6 wall with FG and 1" Poly rigid, U-value 0.042	725.2	1,949	0	0	0
12B-6sw: Wall-Frame, R-11 insulation in 2 x 4 stud cavity, R-6 board insulation, siding finish, wood studs, U-value 0.064	1487.7	6,093	0	0	0
16B-50: Roof/Ceiling-Under Attic with Insulation on Attic Floor (also use for Knee Walls and Partition Ceilings), Vented Attic, No Radiant Barrier, Dark Asphalt Shingles or Dark Metal, Tar and Gravel or Membrane, R-50 insulation, U-value 0.02	2728	3,491	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.09	30	173	0	0	0
22A-pl: Floor-Slab on grade, No edge insulation, no insulation below floor, any floor cover, passive, light dry soil, U-value 0.989	46	2,912	0	0	0
Subtotals for structure:		21,611	0	0	0
People:	0		0	0	0
Equipment:			0	0	0
Lighting:	0			0	0
Ductwork:		0	0	0	0
Infiltration: Winter CFM: 270, Summer CFM: 138		13,898	0	0	0
Ventilation: Winter CFM: 0, Summer CFM: 0		0	0	0	0
Hot Water Piping, 50 ft. Total:		1,075	0	0	0
Total Building Load Totals:		36,584	0	0	0

Check Figures

Total Building Supply CFM:	0	CFM Per Square ft.:	0.000 *
Square ft. of Room Area:	2,728	Square ft. Per Ton:	0 **
Volume (ft ³):	33,000***		

* Based on area of rooms being heated or cooled (whichever governs system) rather than entire floor area.

** Based on area of rooms being cooled.

***Indicated volume is based on custom building volume.

Building Loads

Total Heating Required Including Ventilation Air: 36,584 Btuh 36.584 MBH

Notes

Rhvac is an ACCA approved Manual J, D and S computer program.

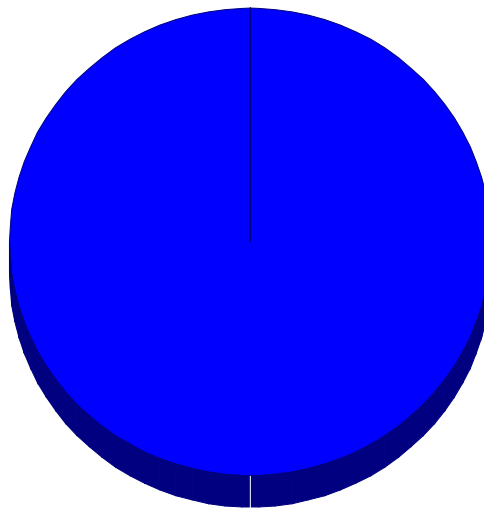
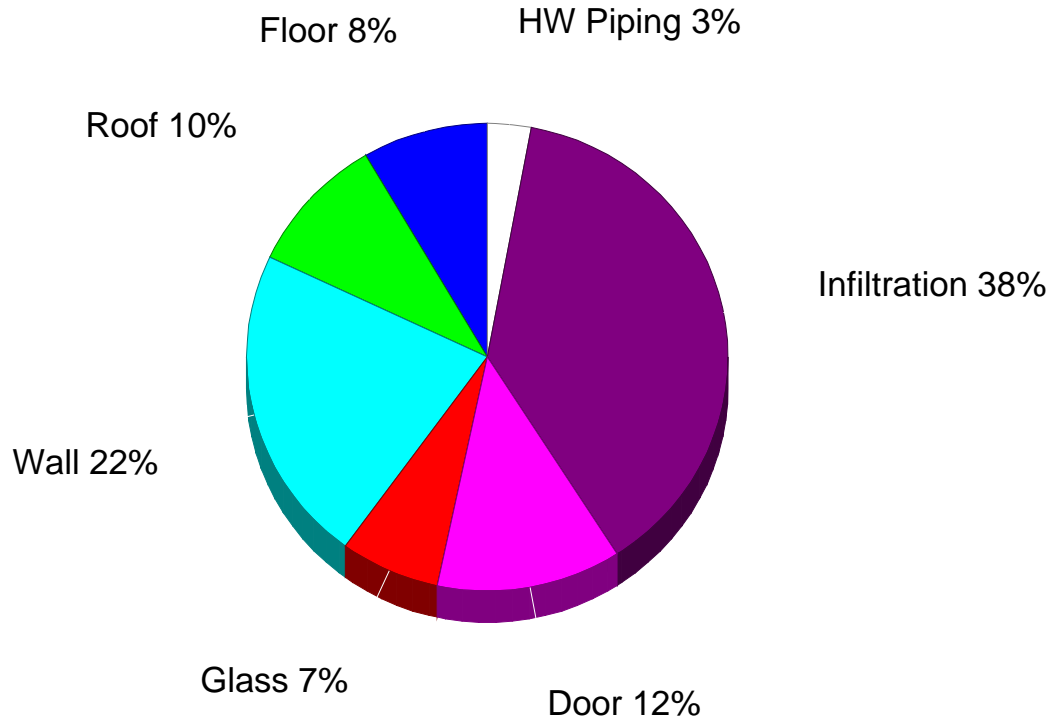
Calculations are performed per ACCA Manual J 8th Edition, Version 2, and ACCA Manual D.

All computed results are estimates as building use and weather may vary.

Be sure to select a unit that meets both sensible and latent loads according to the manufacturer's performance data at your design conditions.



Building Pie Chart



100.0%

*Meriden Fire Station
Energy Cost Analysis*

for

Liberty Utilities & Town of Plainfield



**ENERGY
AUDIT**

Residential and Light Commercial
Energy Analysis

Prepared By:

Margaret Dillon
S.E.E.D.S.

Thursday, March 26, 2020



Project Information

Project Title:	Meriden Fire Station Wednesday,	Company Name:	S.E.E.D.S.
Designed By:		Company Rep.:	Margaret Dillon
Project Date:	March 25, 2020	Company Address:	
Project Comment:		Company City:	
Client Name:	Liberty Utilities & Town Of Plainfield	Company Phone:	
Client Address:		Company Fax:	
Client City:		Company Comment:	
Client Phone:			
Client Fax:			
Client Comment:			

Cooling Equipment System 1

Model Type: Standard Air Conditioner
Model Number:
Capacity: 0 Btuh
Efficiency: 0

Heating Equipment System 1

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 150,000 Btuh
Efficiency: 82 AFUE
System Description: Existing Conditions

Cooling Equipment System 2

Model Type: Standard Air Conditioner
Model Number:
Capacity: 0 Btuh
Efficiency: 0

Heating Equipment System 2

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 150,000 Btuh
Efficiency: 82 AFUE
System Description: After ESM 1

Cooling Equipment System 3

Model Type: Standard Air Conditioner
Model Number:
Capacity: 0 Btuh
Efficiency: 0

Heating Equipment System 3

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 150,000 Btuh
Efficiency: 82 AFUE
System Description: After ESM 2

Cooling Equipment System 4

Model Type: Standard Air Conditioner
Model Number:
Capacity: 0 Btuh
Efficiency: 0

Heating Equipment System 4



Heating Equipment **System 4**

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 150,000 Btuh
Efficiency: 82 AFUE

System Description: After ESM 3

Cooling Equipment **System 5**

Model Type: Standard Air Conditioner
Model Number:
Capacity: 0 Btuh
Efficiency: 0

Heating Equipment **System 5**

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 150,000 Btuh
Efficiency: 82 AFUE

System Description: After ESM 4

Cooling Equipment **System 6**

Model Type: Standard Air Conditioner
Model Number:
Capacity: 0 Btuh
Efficiency: 0

Heating Equipment **System 6**

Model Type: Fuel Oil Boiler
Model Number:
Capacity: 150,000 Btuh
Efficiency: 82 AFUE

System Description: After ESM 5



Project Summary

General Project Information

Project Title:	Meriden Fire Station	Company Name:	S.E.E.D.S.
Project Date:	Wednesday, March 25, 2020	Company Rep:	Margaret Dillon
Client Name:	Liberty & Plainfield	Company E-Mail:	mdillon@myfairpoint.net
		Address:	

Design Data

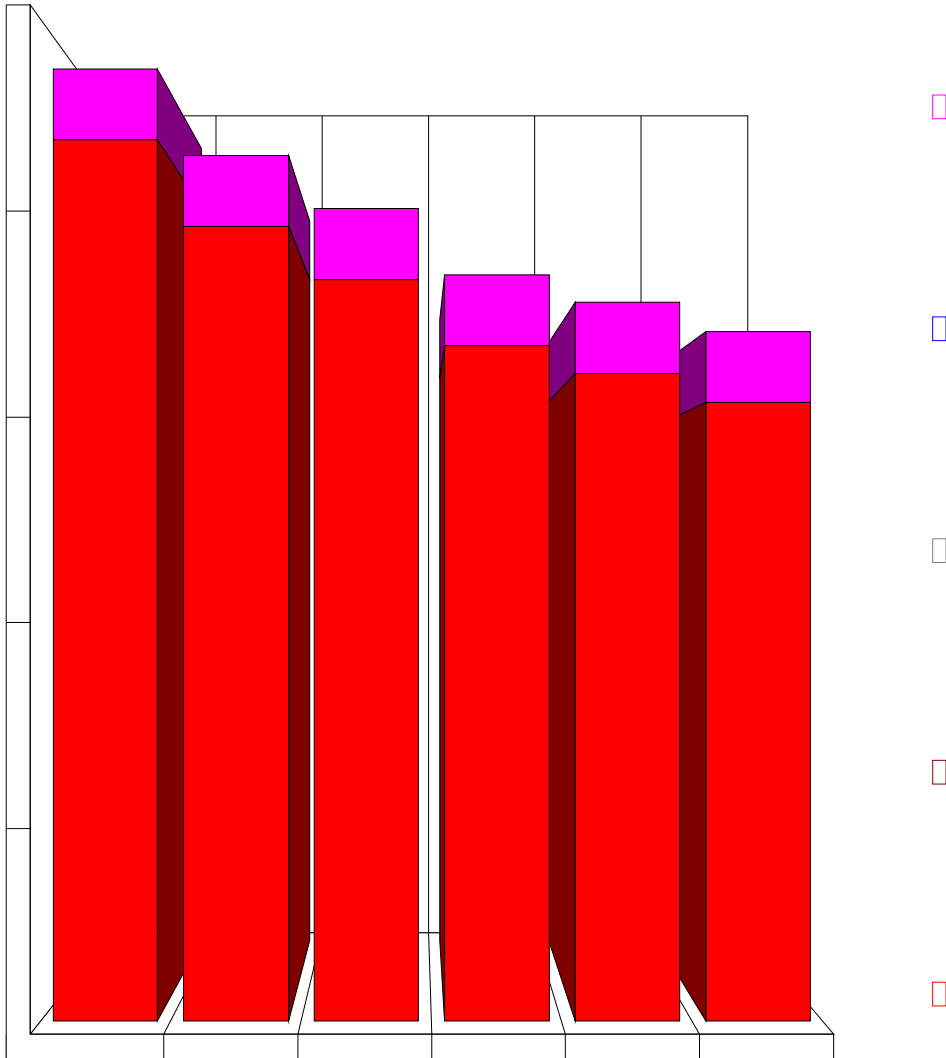
Building Area:	2,728 sq.ft.	Heating Load:	70,790 Btuh
People:	0	Loads Adj. Factor:	0.50
Occupancy:	0	AC On Temp.:	0 °F
Actual City:	Meriden NH		
Weather Ref. City:	Lebanon, New Hampshire		
Summer Outdoor:	86 °F	Winter Outdoor:	-3 °F
Summer Indoor:	75 °F	Winter Indoor:	61 °F
Cooling Hours:	0	Degree Days:	7,200

Annual Operating Cost Estimate

System Description	Fuel Rates Set	Total Heating Cost	Total Cooling Cost	Annual Service Charges	Total Oper. Cost	Average Monthly Cost
Existing Conditions	1	\$2,198	\$0	\$176	\$2,374	\$198
After ESM 1	1	\$1,982	\$0	\$176	\$2,158	\$180
After ESM 2	1	\$1,850	\$0	\$176	\$2,026	\$169
After ESM 3	1	\$1,685	\$0	\$176	\$1,861	\$155
After ESM 4	1	\$1,617	\$0	\$176	\$1,793	\$149
After ESM 5	1	\$1,544	\$0	\$176	\$1,720	\$143



Project Summary Bar Chart





Input Data - System 1 - Existing Conditions

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:		
Efficiency:	0.00	
Capacity:	0 Btuh	
Cooling Load:	0 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$0.00

Heating

System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	150,000 Btuh	\$1,428.41
Oversize Penalty:	1.35	\$769.14
Heating Load:	52,079 Btuh	
Annual Cost (Degree Days Method):		\$2,197.55

Other Costs

Service Charges:		\$176.04
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Total Cost

Total Annual Operating Cost:		\$2,373.59
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Input Data - System 2 - After ESM 1

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:		
Efficiency:	0.00	
Capacity:	0 Btuh	
Cooling Load:	0 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$0.00

Heating

System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	150,000 Btuh	\$1,288.28
Oversize Penalty:	1.35	\$693.69
Heating Load:	46,970 Btuh	
Annual Cost (Degree Days Method):		\$1,981.97

Other Costs

Service Charges:		\$176.04
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Total Cost

Total Annual Operating Cost:		\$2,158.01
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Input Data - System 3 - After ESM 2

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:		
Efficiency:	0.00	
Capacity:	0 Btuh	
Cooling Load:	0 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$0.00

Heating

System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	150,000 Btuh	\$1,202.62
Oversize Penalty:	1.35	\$647.57
Heating Load:	43,847 Btuh	
Annual Cost (Degree Days Method):		\$1,850.19

Other Costs

Service Charges:		\$176.04
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Total Cost

Total Annual Operating Cost:		\$2,026.23
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Input Data - System 4 - After ESM 3

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:		
Efficiency:	0.00	
Capacity:	0 Btuh	
Cooling Load:	0 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$0.00

Heating

System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	150,000 Btuh	\$1,095.11
Oversize Penalty:	1.35	\$589.67
Heating Load:	39,927 Btuh	
Annual Cost (Degree Days Method):		\$1,684.78

Other Costs

Service Charges:		\$176.04
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Total Cost

Total Annual Operating Cost:		\$1,860.82
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Input Data - System 5 - After ESM 4

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:		
Efficiency:	0.00	
Capacity:	0 Btuh	
Cooling Load:	0 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$0.00

Heating

System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	150,000 Btuh	\$1,050.76
Oversize Penalty:	1.35	\$565.79
Heating Load:	38,310 Btuh	
Annual Cost (Degree Days Method):		\$1,616.55

Other Costs

Service Charges:		\$176.04
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Total Cost

Total Annual Operating Cost:		\$1,792.59
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Input Data - System 6 - After ESM 5

Estimated Cost

Cooling

System Type:	Standard Air Conditioner	
Model:		
Efficiency:	0.00	
Capacity:	0 Btuh	
Cooling Load:	0 Btuh	
Annual Cost (Spec Cooling Hours Method):		\$0.00

Heating

System Type:	Fuel Oil Boiler	
Model:		
Efficiency:	82 AFUE	
Capacity:	150,000 Btuh	\$1,003.42
Oversize Penalty:	1.35	\$540.30
Heating Load:	36,584 Btuh	
Annual Cost (Degree Days Method):		\$1,543.72

Other Costs

Service Charges:		\$176.04
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Total Cost

Total Annual Operating Cost:		\$1,719.76
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