

Technical Report: Part Three



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Executive Summary

Technical Report Three evaluated the Elementary School One's mechanical system by examining the design requirements, LEED, equipment cost and operation. Information from Technical Report One and Two are used and referenced in this report. Elementary School One is a school located in Town, Maryland. The existing school building was renovated and an addition was built on the west side of the building. Elementary School One modernization finished in 2011. The total mechanical cost for the entire project is \$3,216,046 which is 16.5% of the total cost of construction. The VRF system used increases the initial cost, but will save energy in the long term.

The mechanical system consists of 4 packaged RTUs, 3 DOAS RTUs with VRF system and addition FCUs and radiator heating are used throughout the building. The VRF systems has 3 roof top air-cooled condensing units. The cooling and heating air side use refrigerant and electricity to condition the spaces. Two natural gas boilers that serve the domestic water loads. A LEEDv4 analysis was completed for the mechanical system. The original design received School LEED Gold Certification and may not pass with the new LEEDv4. The design may achieve certification, but more documentation is needed. With the current documentation, the building received 13 points of the credits reviewed. More LEED points could be achieved with further documentation of energy use history, commissioning and etc.

Building Overview

Building Name:	Elementary School One
Location and Site:	Town, Maryland
Dates of Construction:	2010 – August 2011
Size:	84,400 sq. ft.
Number of Stories:	3 above and 1 below grade

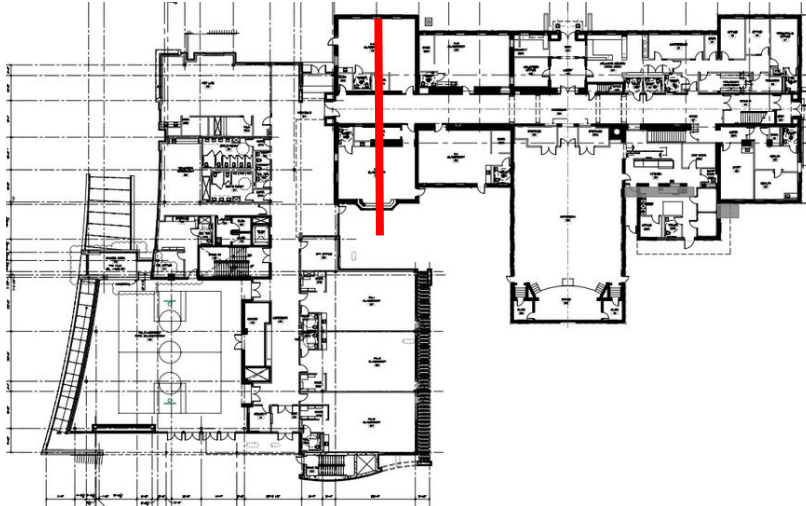


Figure 1: First Floor Plan.

The red line separates the existing building and the addition. The existing is on the right and the addition is on the left.

Mechanical Systems Summary

Elementary School One modernization involved a renovation of the existing building and adding an addition on the west side. All new mechanical systems were applied to both the existing and the addition. The mechanical system has three dedicated outside air RTUs that supply VAV boxes in each space. Each space then exhausts air back to the RTUs for heat wheel. There are three air-cooled VRF systems that condition these spaces with dedicated outside area.

Two RTUs serve the cafeteria and two serve the multipurpose room. There are also base board radiators and cabinet heaters in some of the spaces near the exterior. In the administrative section of the existing building, an AHU conditions the spaces with its own outside air intake. There are small AHUs that serve the computer room and telecom room, but they were not included in my analysis because of the insignificant impact.

The figures below show the areas each unit serves.

- Blue- RTU-1 and 2 serve cafeteria
- Orange- RTU-3 and 4 DOAS serve the existing building (heat wheel)
- Purple- RTU-5 DOAS serve the addition (heat wheel)
- Green- RTU-6 and 7 serve the multipurpose room
- Red- AHU serves administrative offices

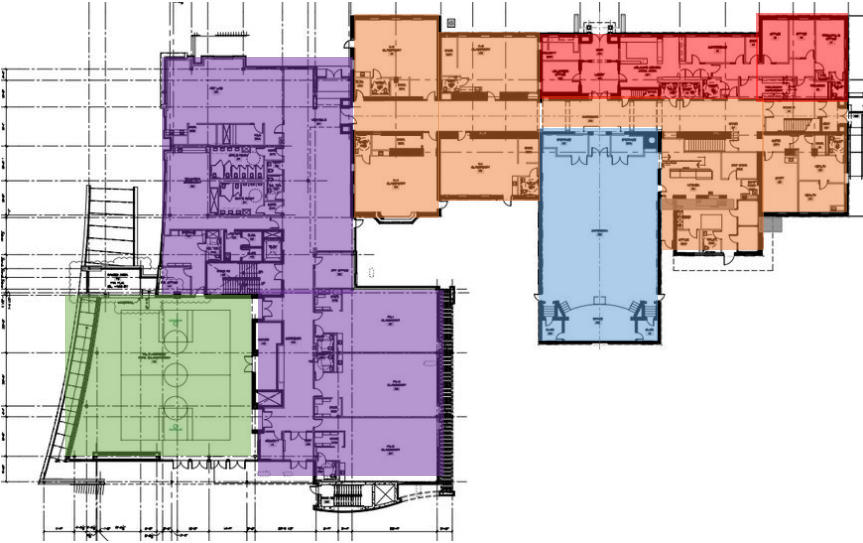


Figure 2: First Floor Block Layout

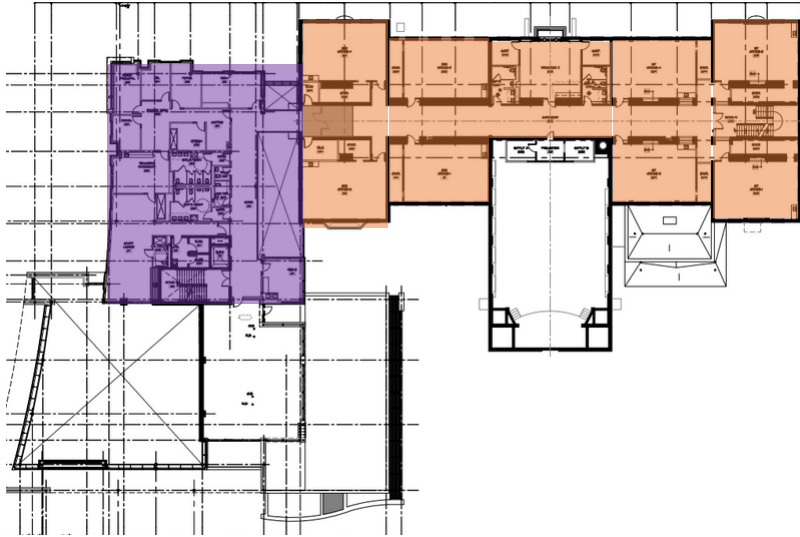


Figure 3: Second Floor Block Layout

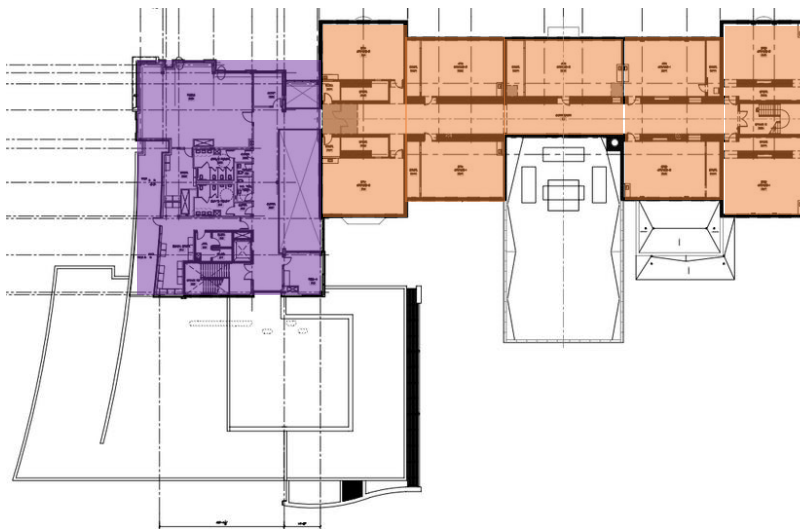


Figure 4: Third Floor Block Layout

Mechanical System Design

Design Objectives

Elementary School One modernization main goals were to expand for more classrooms and improve comfort to allow for better learning. The modernization of the school achieved LEED Gold Certification which surpassed the goal of becoming LEED certified. The mechanical systems was one of the major contributors toward reaching LEED Gold. Building comfort was achieved for the different spaces by utilizing various system types and controls. Outside air, heating and cooling loads were based on ASHRAE standards, but adjusted for the different spaces. To reach thermal comfort, the mechanical systems must provide enough conditioning and control while minimizing the energy use.

Design Conditions

The outdoor design conditions are based on ASHRAE Handbook weather information from Baltimore, Maryland. The indoor design conditions are based on the owner’s needs and the engineer’s input. The relative humidity of the space will be controlled to maintain between 48% and 55% RH. Table 1 below summarizes the design temperatures for the building systems.

Outdoor and Indoor design conditions

	Summer	Winter
Designed Dry Bulb (°F)	91	13
Designed Wet Bulb (°F)	77	-
Indoor Air Temperature (°F)	75	72

Table 1: Weather based on Baltimore, Maryland data.

Ventilation Requirements

The designed ventilation rates were based on ASHRAE Standard 62.1. Most of the spaces are served by the dedicated outside air units which have a set minimum flow rate to ensure compliance. The other spaces, cafeteria and multipurpose room, are served by packaged roof top units that will provide mixed air to the spaces. In Appendix A, the detailed outdoor air calculations for each space can be found. Table 2 below is a summary of the ventilation rates for each unit.

Unit	Supply CFM	Required OA CFM	Design OA CFM	OA%
RTU-1,2	15,000	2,876	5,000	33.3%
RTU-3	9,180	4,327	9,180	100%
RTU-4	5,600	2,881	5,600	100%
RTU-5	8,575	3,573	8,575	100%
RTU-6,7	16,000	3,552	5,000	31.3%

Table 2: RTU Ventilation Summary

Heating and Cooling Requirements

The heating and cooling loads were calculated using a model in Trane Trace 700. The estimated modeled loads are compared with the design loads in the Tables 3 and 4 below. The estimated loads are larger than the designed loads for a couple reasons. The location of the building has been moved to a colder climate and higher estimation of the internal loads. RTU 1, 2, 6 and 7 modeled are close to the designed capacities. These units serve the cafeteria and the multipurpose room and supply over 4 cfm/ sq ft because of the double height ceilings. There was no information on the design loads of AHU that serves the administrative offices, but 1.37 cfm/ sq ft seems to be high for that type of space. The administrative space should be closer to 1.0 cfm/ sq ft. The RTU-3, 4 and 5 loads are largely off by a factor of 50%. This is due to the program limitations. Trane Trace 700 does not allow multiple systems to operate one space and those spaces have dedicated outdoor air (VAV) with VRF system to further condition the space.

The system inputted into the program was a VRF with dedicated outdoor air in the same package unit. This adapted input is skewing my results for those spaces. Also, the controls of the designed system is very elaborate compared to the controls that could be inputted into Trane Trace in the simplified block estimation.

Design Heating and Cooling Loads

Modeled:

	Cooling Capacity (MBh)	Heating Capacity (MBh)	cfm/sq ft
AHU	57.8	112.1	1.37
RTU-1,2	344.8	118.3	4.47
RTU-3,4	1557.1	1542.11	1.54
RTU-5	1439.6	1181	1.54
RTU-6,7	527.1	145.3	4.07

Table 3: Modeled load calculation results.

Designed:

	Cooling Capacity (MBh)	Heating Capacity (MBh)	cfm/sq ft
AHU	n/a	n/a	n/a
RTU-1,2	309.8	125.7	4.81
RTU-3,4	914.1	932.4	1.1
RTU-5	867.7	742.3	1.1
RTU-6,7	359.8	217.7	3.42

Table 4: Designed load calculation from sponsor.

Mechanical Equipment

Air Handling Units

The rooftop units and air conditioning units combine to serve all the spaces in the building. RTU-3, 4 and 5 in Table 5 are dedicated outside area units. The DOAS units serve the spaces using VAV boxes. There are 59 VAV boxes in the building ranging from 75 cfm to 600 cfm. RTU-1, 2, 6 and 7 are packaged units that condition and provide OA to the space. These spaces are provided with extra heating from 10 electric unit heaters and electric baseboards. The AC units, Table 6, serve individual spaces that needed different loads and schedules. The AC units are a part of a split system with air cooled condensing units, Table 7.

Rooftop Unit Schedule			
Unit No.	Area Served	Supply CFM	Total Load (MBH)
RTU-1	Cafeteria	1625	227
RTU-2	Cafeteria	1625	227
RTU-3	Exist. Bldg.	7475	350
RTU-4	Exist. Bldg.	5175	236.9
RTU-5	Addition	8350	538
RTU-6	Multi-purpose	2250	235
RTU-7	Multi-purpose	2250	235

Table 5: RTU Operation

AC Unit Schedules			
Unit No.	Area Served	CFM	Capacity (MBH)
AC-1	Admin	2200	81.77
AC-2	Computer Rm	1000	30
AC-3	Telecom	800	24

Table 6: ACU Operation

Air Cooled Condensing Units Schedules		
Unit No.	Serving	Capacity (MBH)
ACCU-1	AC-1	95.9
ACCU-2	AC-2	30
ACCU-3	AC-3	24

Table 7: Condensing units for AC Units

VRF Operations

There are three variable refrigerant flow systems that condition the spaces served by the DOAS. The VRF units have cooling and heating capacities seen in Table 8. The VRF is air-cooled to three units on the roof, Table 9. The spaces served by the DOAS can receive conditioned outside air from the RTUs and then the VRF can supply any further conditioning. There are 13 cabinet heaters that serve vestibules, corridors and stairwells if extra heating is needed.

AC Unit Schedules (VRF)		
CFM	Cooling (MBH)	Heating (MBH)
230	7.5	8.5
300	9.6	10.9
420	12.3	13.6
550	19	21
185	7.5	8.5

Table 8: Capacities of VRF Units

Air Cooled Condensing Units Schedules (VRF System)			
Unit No.	Cooling (MBH)	Heating (MBH)	Condenser CFM
CU-VRF-1	439	494	20100
CU-VRF-2	343	386	20100
CU-VRF-3	305	343	13400

Table 9: Condensing Units for VRF Operation

Boilers

The two mechanical rooms located in the bottom floor each have a 399,000 BTUH natural gas boiler. The boilers provide the building with hot water for domestic use. The boiler summary is in Table 10.

Domestic Water Heater Schedule			
Unit No.	Location	Type	BTUH Input
WH-1	New Boiler Rm	Gas	399,000
WH-2	Ex. Boiler Rm	Gas	399,000

Table 10: Boiler Operation

Mechanical System Schematics and Operation

Air Side

The building is served by seven roof top air handling units. The schematic design for the packaged RTUs (1, 2, 6 & 7) can be seen in Figure 5 below. These units have constant supply fan and return fan with VFD control. The fan speed and the damper control will vary depending on the responds from the BAS system. The BAS system will determine the flow based on the space, outside and return air temperatures and humidity. These units must maintain a 30% mixture of outdoor air when the spaces are occupied.

The outside air enters the RTU due to the downstream supply fan and a temperature sensor indicates the OA temperature. The OA will be mixed with some amount of return air unless in economizer mode. This air next goes through a filter with a differential pressure sensor on both sides to indicate filter status. The air is then conditioned and dehumidified by the cooling coil dependent on the space's need. The cooling coil is followed by a freeze stat to prevent any damage. The air goes through the supply fan and is then conditioned by the heating coil if it is needed. The supply air temperature is censored along with the spaces temperature and CO2 concentration. The return air is pulled by the exhaust fan. As the RA enters the unit, a smoke detector and RA temperature sensor monitor the air. A percentage of the return air can be mixed with the OA using the RA dampers or exhausted out.

The roof top units 3, 4, & 5 (Figure 6) are a part of a designated outside air system (DOAS). These units have supply and exhaust fans that are both VFD. The units supply 100% OA

to the spaces they serve. To make this unit more efficiency, a heat wheel used to transfer heat from the exhaust to the supply air depending on the season. The energy wheel itself has dampers for bypass if less heat transfer is needed. The air goes through a similar path as the unit above: filter, coiling cool, heating coil, and the space. These DOAS units have the same sensors as listed for pervious unit. The DOAS unit supplies the spaces through VAV boxes that has damper. The VAV box changes the flow with the damper and can also reheat the air with the electric duct heater. The return air is pulled from each space and exhaust outside. The DOAS system has a set minimum OA flow rate which is controlled by the unit itself.

RTUs- 1, 2, 6 & 7

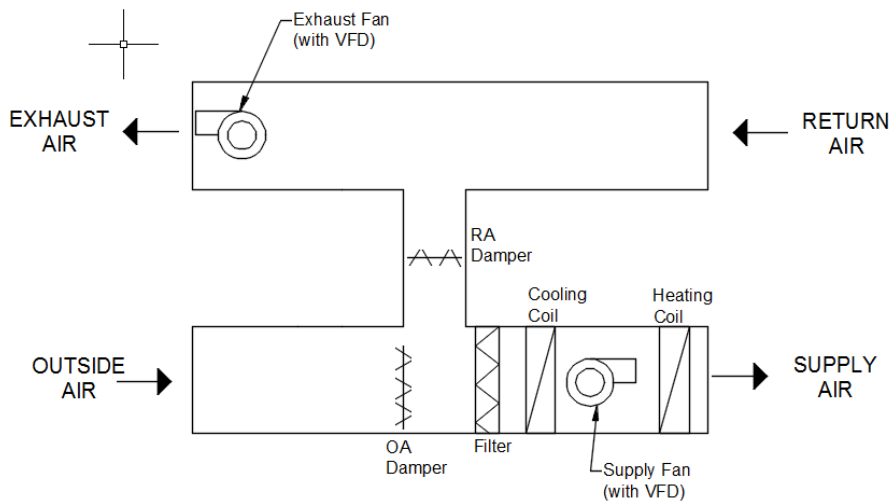


Figure 5: Schematic of Packaged RTUs

RTUs- 3, 4 & 5

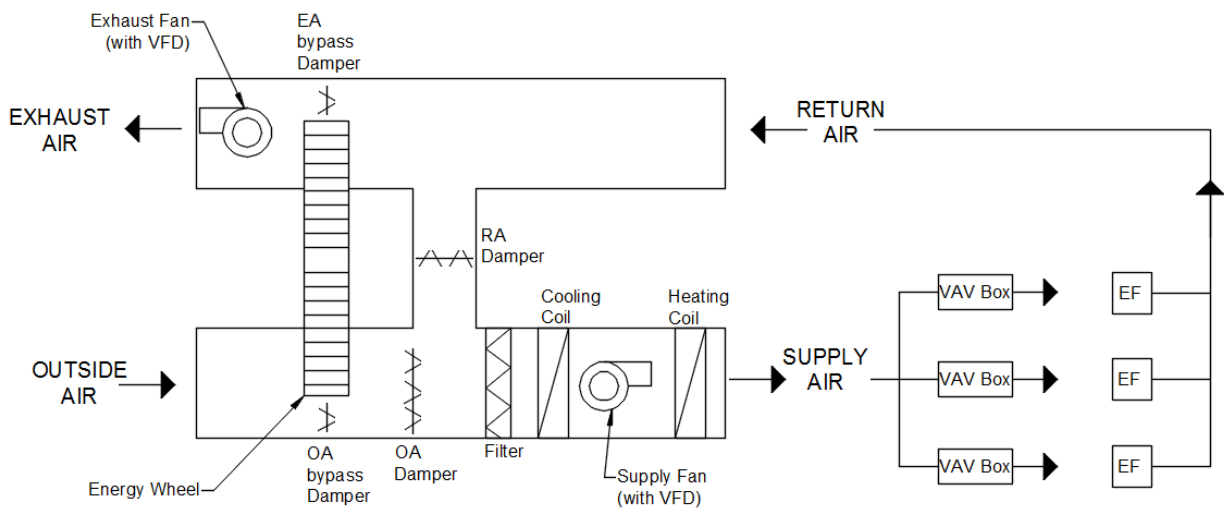


Figure 6: Schematic of DOAS RTUs

Refrigerant Side

There are three separate variable refrigerant flow systems that serve the building using R-410 as the refrigerant. The schematic can be seen below in Figure %. The VRF system consists of an air-cooled condensing unit that serves several header units that distributes the refrigerant to the VRF boxes that condition the air in each space. The condensing units are on the roof top and transfer heat to the outside air. Three refrigerant pipes go from the condensing unit to the header units. The three pipes have the refrigerant with different enthalpy as seen below. The header unit controls the flow of refrigerant to the individual space boxes. The flow is controlled by the temperature in each space. The boxes in each space are basically fan coil units. The fan pulls in air from the space, conditions the air with the coils and supplies that air back to the space. The VRF systems have self-monitoring system that can be controlled by the BAS system.

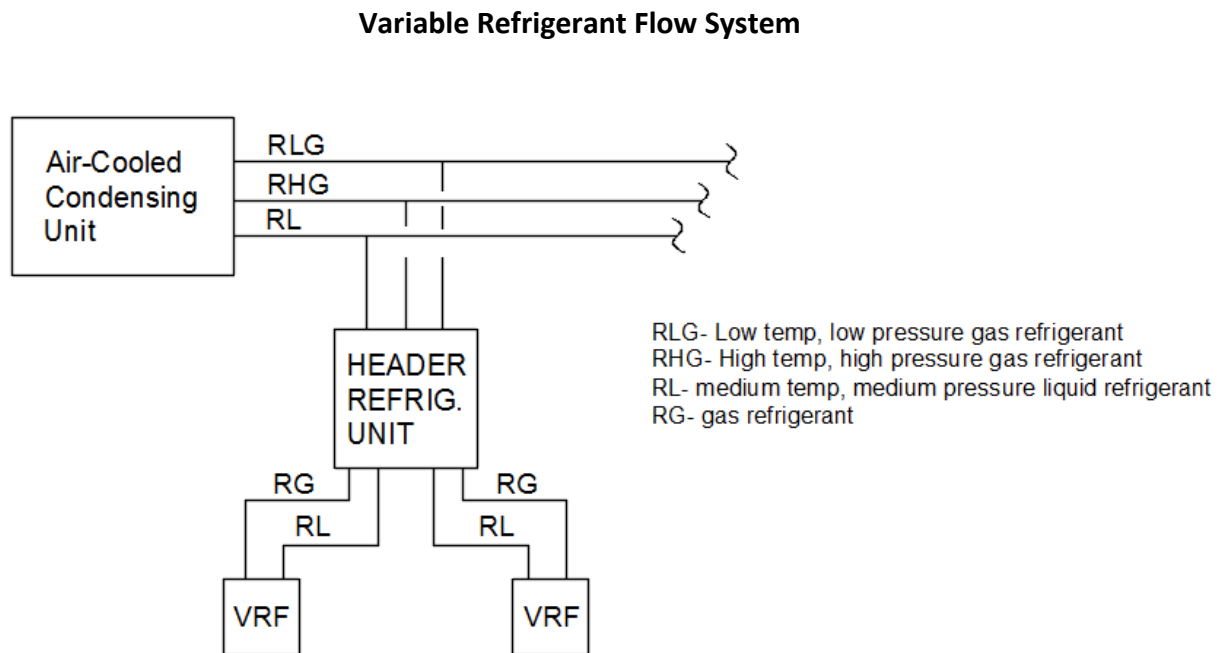


Figure 7: VRF system Schematic

Mechanical System Evaluation

Energy Sources

Elementary School One’s energy sources are electricity and natural gas. Electricity provides power to most of the building and the natural gas provides power to the two water heaters. Both of these energy sources come from the city provider. Table 11 summarizes the utility rates.

Energy Source	Average Rate
Electricity	\$0.131/kWH
Natural Gas	\$1.044/therm

Table 11: Average Utility Rates

Annual Energy Use

Elementary School One consumes 4,845,829 kBtu/yr, which can be seen in Table 12 and Figure 8. Most of the energy consumed by the building is due to the lights. School only operates during normal school hours plus extracurricular activities after hours. The energy consumed cannot be decreased much because of the lighting requirements of ASHRAE. The second largest energy usage is mechanical cooling. This includes each RTU and AHU to cool the spaces. The school is not in full operation during the summer so the set temperature is higher so less cooling is needed. The operational spaces during the summer are mostly administrative offices which have their own AHU to condition that space.

Equipment Energy Consumption

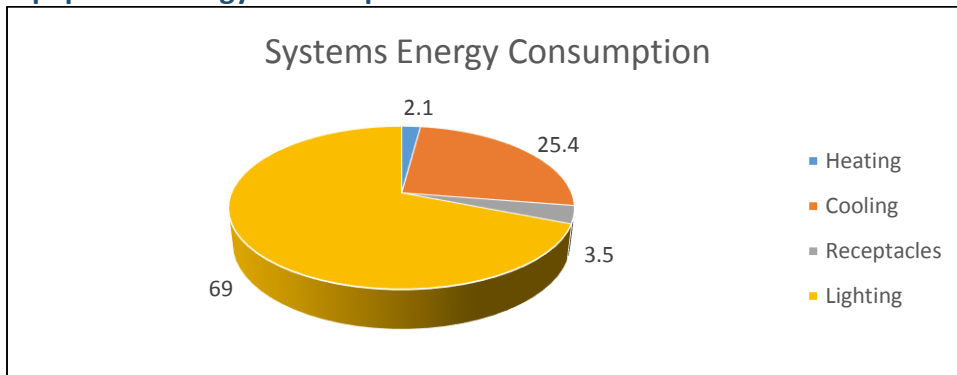


Figure 8: Energy Consumption Pie Chart

	% of Total Building Energy	Total Building Energy (kBtu/yr)
Heating	2.1	99,919
Cooling	25.4	1,232,861
Receptacles	3.5	168,870
Lighting	69	3,344,179
Total	100	4,845,829

Table 12: Equipment energy consumption modeled in Trane.

Building Energy Cost Analysis

The energy cost was found from the areas electricity and gas providers. The cost of electricity currently in the area is 13.1 cents per kWh. The cost of gas is \$1.044 per therm currently and one therm is equal to 29.3 kWh.

The yearly estimated cost of electricity is \$46,979 and the estimated cost of gas is \$602. This brings the total operation cost of the equipment to \$47,581. The building conditioned spaces are 55,927 sq ft and the utility cost per area is 0.85 \$/sq ft.

Mechanical System First Cost

The direct cost of construction is compared to the mechanical cost below in Table 13. The total mechanical cost for the entire project is \$3,216,046 which is 16.5% of the total cost of construction.

		Estimated Direct Cost	Estimated Square Foot Cost	Percent of Construction
Existing Building Renovation (45,455 sqft)	Mechanical	\$1,999,293	\$43.98	10.3%
	Total	\$7,963,236	\$163.77	40.9%
New Addition (35,790 sqft)	Mechanical	\$1,216,753	\$34.00	6.25%
	Total	\$11,517,383	\$321.80	59.1%
Total Construction		\$19,480,619	\$239.78	100%

Table 13: Construction Cost Summary

Loss of Usable Space

There are two mechanical rooms located in the bottom floor of each the existing and addition part of the building. Several mechanical shafts cut through each floor, but each shaft is utilized with plumbing and mechanical runs. The total loss of floor space is 2,100 sq. ft. which is only 3% of the building.

LEED Evaluation

Elementary School One achieved LEED for Schools 2007 Gold Certification. The following is an evaluation of the mechanical systems LEED credits based on the current USGBC LEEDv4.

Energy & Atmosphere Credits

EA Prerequisite 1: Fundamental Commissioning and Verification (Complies)

The purpose of this prerequisite is to verify that the mechanical system is installed and operates as the design intended. Commissioning and verification were completed by a third party hired by the owner.

EA Prerequisite 2: Minimum Energy Performance (Complies)

The purpose of this prerequisite to reduce the environmental and economic harms of excessive energy use by achieving a minimum level of energy efficiency for the building and its systems. The minimum energy cost savings of 5% is required for all new construction projects and the energy model from the designer has savings of 19.4%.

EA Prerequisite 3: Building-Level Energy Metering (Complies)

The purpose of this prerequisite is to ensure that energy usage by the building is documented. New electricity and natural gas meters were installed to accurately measure the building consumption.

EA Prerequisite 4: Fundamental Refrigerant Management (Complies)

The purpose of this prerequisite is to reduce stratospheric ozone depletion. The designed systems have zero use of CFC-Based refrigerants.

EA Credit 1: Enhanced Commissioning (0/6 pts)

The purpose of this credit is to further support the design, construction, and operation of a project that meets the owner's project requirements. No documentation of enhanced commissioning is available.

EA Credit 2: Optimize Energy Performance (7/16 pts)

The purpose of this credit is to achieve increasing levels of energy performance beyond prerequisite standard. The energy model predicted energy cost savings of 19.4% from the baseline. The building falling under new construction 7 of 16 points are achieved.

EA Credit 3: Advanced Energy Metering (1/1 pts)

The purpose of this credit is to ensure that whole-building energy sources used by the building are documented to allow for possible energy savings in the future. New electricity and natural gas meters were installed for collecting energy usage data.

EA Credit 4: Demand Response (0/2 pts)

The purpose of this credit is increase participation in demand response technologies and programs to reduce energy usage. This credit is new for LEEDv4 so no documentation is available for demand response.

EA Credit 5: Renewable Energy Production (0/3 pts)

The purpose of this credit is to reduce the environmental and economic harms associated with fossil fuel energy. There is no renewable energy production on site.

EA Credit 6: Enhanced Refrigerant Management (1/1 pts)

The purpose of this credit is to reduce ozone depletion and to support early compliance with the Montreal Protocol. The packaged AC units and split AC units both use R-140a as the refrigerant. To achieve this credit, the refrigerant impact per ton must be < 100. The school's systems meets the requirement and the data can be seen in Table 14.

Refrigerant	Q (tons)	Refrigerant Impact per ton	Credit (<100)
R-410a	324	95.7	Yes

Table 14: EA Credit 6 Data

EA Credit 7: Green Power and Carbon Offsets (0/2 pts)

The purpose of this credit is to encourage the reduction of greenhouse gas emissions through use of renewable energy, grid source technologies and carbon mitigation projects. No documentation was available on green power or carbon offsets.

Indoor Environmental Quality Credits

EQ Prerequisite 1: Minimum Indoor Air Quality Performance (Complies)

The design complies with this section by meeting the minimum ventilation requirements of ASHRAE 62.1 besides two spaces. This may be due to the design using older version of standards. These spaces have operable windows which allow the spaces to comply. The calculations and analysis can be seen in Appendix A.

EQ Prerequisite 2: Environmental Tobacco Smoke Control (Complies)

The school does not allow smoking on site and the proper signage is posted around the facility. The school complies with the prerequisite.

EQ Prerequisite 3: Minimum Acoustic Performance (Complies)

The previous versions of LEED do not include this prerequisite. This new requirements states the background noise level in learning spaces must be less than 40 dBA and exterior treatment for schools near noisy areas. The addition of the school must comply, but the original building falls under the historic preservation exception.

EQ Credit 1: Enhanced Indoor Air Quality Strategies (1/2 pts)

The purpose of this credit is improve indoor air quality for the occupants. The design does have CO2 sensors in each occupied space, but does not design 30% OA increase of the requirement to achieve the 2 points in this section.

EQ Credit 4: Indoor Air Quality Assessment (0/2 pts)

The purpose of this credit to establish better quality indoor air in the building after construction and during occupancy. No documentation was found on air testing or air flush outs. This credit was not in the previous versions of LEED.

EQ Credit 5: Thermal Comfort (1/1 pts)

The school complies with ASHRAE 55-2010. The set points for temperature, humidity and ventilation follow that standard. The thermal comfort satisfies 80% of the occupants by having thermostats and occupancy sensors in each space controlling the individual space fan coil unit.

EQ Credit 9: Acoustical Performance (2/2 pts)

The purpose of this credit is to provide learning spaces that promotes occupants' well-being, productivity, and communications through acoustic design. An acoustical consultant was hired and verified that the spaces do meet School LEED Ratings. The problem spaces do not affect LEED rating because they are not learning spaces.

Overall Mechanical System Evaluation

Elementary School One modernization main goals were to expand for more classrooms and improve comfort to allow for better learning while being energy efficient. One of the main difficulties in the design is to balance energy efficient and initial cost of construction. The building's mechanical system provides comfortable learning spaces while meeting requirements of ventilation and conditioning.

The DOAS roof top units combined with the VRF system provides thermal and acoustical comfort to the learning spaces. The combination of systems make for very energy efficient mechanical system. The packaged roof top units that serve the cafeteria and multipurpose room fit the needs for the space. The conditioning of these spaces might be able to be served in a more energy efficient way.

The cost of the modernization to Elementary School One was \$19,480,619 with the mechanical system cost at \$3,216,046. The sustainability of the systems should be worth the initial cost of the system. Through further research and evolution, the building's mechanical systems could save more energy by implanting new equipment and renewable energy sources.

The original design of the mechanical system meets the design objectives of the owner and requirements of the standards. More evaluations and research may provide ways to other options and technologies that may work for Elementary School One.

References

ASHRAE (2013) Standard 62.1- Ventilation for Acceptable Indoor Air Quality

ASHRAE (2013) Standard 90.1- Energy Standard For building Except Low-Rise Residential Buildings

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Appendix A

Design Ventilation Requirements

Existing Building

ASHRAE 62.1 2013 Section 6- Ventilation Rate													
Existing Rooms		Designed Calculations			Ventilation Rate Factor							Meets ASHRAE	Difference
Floor	Room	Area (sf)	# of People	Min OA (cfm)	Space Type	Rp	Occupant Density	Pz	Ra	Az	Required OA		
1st	Cafeteria	3550	249	4980	Multiuse	7.5	100	355	0.06	3550	2876	YES	
1st	RM 123	210	2	40	Office	5	5	1	0.06	210	18	YES	
1st	RM 124	201	2	40	Office	5	5	1	0.06	201	17	YES	
1st	RM 101	780	30	450	Class	10	35	27	0.12	780	367	YES	
1st	RM 102	623	30	450	Class	10	35	22	0.12	623	293	YES	
1st	RM 125	294	3	60	Office	5	5	1	0.06	294	25	YES	
1st	CORR	1861	0	186	Corridor	0	0	0	0.06	1861	112	YES	
1st	RM 132	647	30	450	Class	10	35	23	0.12	647	304	YES	
1st	RM 133	688	30	450	Class	10	35	24	0.12	688	323	YES	
2nd	CONF	200	10	200	Conference	5	50	10	0.06	200	62	YES	
2nd	RM 201	706	30	450	Class	10	35	25	0.12	706	332	YES	
2nd	RM 202	706	30	450	Class	10	35	25	0.12	706	332	YES	
2nd	RM 203	494	4	80	Office	5	5	2	0.06	494	42	YES	
2nd	RM204	704	30	450	Class	10	35	25	0.12	704	331	YES	
2nd	RM 205	704	30	450	Class	10	35	25	0.12	704	331	YES	
2nd	CORR	1884	0	188	Corridor	0	0	0	0.06	1884	113	YES	
2nd	RM 208	704	30	450	Class	10	35	25	0.12	704	331	YES	
2nd	RM 209	704	30	450	Class	10	35	25	0.12	704	331	YES	
2nd	RM 211	707	30	450	Class	10	35	25	0.12	707	332	YES	
2nd	RM 212	706	30	450	Class	10	35	25	0.12	706	332	YES	
3rd	RM 301	706	30	450	Class	10	35	25	0.12	706	332	YES	
3rd	RM 302	708	30	450	Class	10	35	25	0.12	708	333	YES	
3rd	RM 303	940	30	450	Class	10	35	33	0.12	940	442	YES	
3rd	RM 304	703	30	450	Class	10	35	25	0.12	703	330	YES	
3rd	RM 305	704	30	450	Class	10	35	25	0.12	704	331	YES	
3rd	RM 307	700	30	450	Class	10	35	25	0.12	700	329	YES	
3rd	RM 308	705	30	450	Class	10	35	25	0.12	705	331	YES	
3rd	RM 309	707	30	450	Class	10	35	25	0.12	707	332	YES	
3rd	RM 310	706	30	450	Class	10	35	25	0.12	706	332	YES	
3rd	CORR	2004	0	200	Corridor	0	0	0	0.06	2004	120	YES	

Building Addition

ASHRAE 62.1 2013 Section 6- Ventilation Rate													
Addition Rooms		Designed Calculations			Ventilation Rate Factor								
Floor	Room	Area (sf)	# of People	Min OA (cfm)	Space Type	Rp	Occupant Density	Pz	Ra	Az	Required OA	Meets ASHRAE	Difference
1st	AFT 136	203	2	40	Office	5	5	1	0.06	203	17	YES	
1st	ART LAB 135	1016	30	450	Art Class	10	20	20	0.18	1016	386	YES	
1st	CORR 144	2810	0	281	Corridor	0	0	0	0.06	2810	169	YES	
1st	PE OFFICE149	280	2	40	Office	5	5	1	0.06	280	24	YES	
1st	PK CLASS 137	1007	30	450	Class PK	10	25	25	0.12	1007	373	YES	
1st	PK CLASS 138	1007	30	450	Class PK	10	25	25	0.12	1007	373	YES	
1st	PK CLASS 139	1007	30	450	Class PK	10	25	25	0.12	1007	373	YES	
1st	STORAGE 147	128	0	19	Storage	5	2	0	0.06	128	9	YES	
1st	TEACHER 152	548	4	80	Office	5	5	3	0.06	548	47	YES	
1st	SECURITY 141	97	1	20	Office	5	5	0	0.06	97	8	YES	
1st	MULTIPURPOSE	4015	269	4035	Multiuse	7.5	100	402	0.06	4015	3252	YES	
2nd	SPEECH 230	132	1	20	Office	5	5	1	0.06	132	11	YES	
2nd	ASSIST 233	191	2	40	Office	5	5	1	0.06	191	16	YES	
2nd	CORR 216	940	0	94	Corridor	0	0	0	0.06	940	56	YES	
2nd	ESL 234	132	1	20	Office	5	5	1	0.06	132	11	YES	
2nd	PSYCH	156	2	40	Office	5	5	1	0.06	156	13	YES	
2nd	RES 213	263	2	40	Office	5	5	1	0.06	263	22	YES	
2nd	RES 214	251	2	40	Office	5	5	1	0.06	251	21	YES	
2nd	SOCIAL 229	135	1	20	Office	5	5	1	0.06	135	11	YES	
2nd	STAFF LOUGE 217	746	22	440	Breakroom	5	50	37	0.12	746	276	YES	
2nd	STUDENT SERV 23	350	3	60	Office	5	5	2	0.06	350	30	YES	
2nd	TEACHER 228	380	3	60	Office	5	5	2	0.06	380	32	YES	
3rd	BOOK STOR 314	501	0	75	Storage	5	2	1	0.06	501	35	YES	
3rd	CONF 326	150	8	160	Conference	5	50	8	0.06	150	47	YES	
3rd	CORR 327	935	0	94	Corridor	0	0	0	0.06	935	56	YES	
3rd	MUSIC 325	1240	30	450	Music	10	35	43	0.06	1240	508	NO	58.4
3rd	RES 312	251	2	40	Office	5	5	1	0.06	251	21	YES	
3rd	STORAGE 324	235	0	35	Storage	5	2	0	0.06	235	16	YES	
Basemen	AV CLOSET L17	198	2	40	Storage	5	2	0	0.06	198	14	YES	
Basemen	BOOK STOR L13	500	0	75	Storage	5	2	1	0.06	500	35	YES	
Basemen	CONF L20	180	6	120	Conference	5	50	9	0.06	180	56	YES	
Basemen	CONF L33	300	10	200	Conference	5	50	15	0.06	300	93	YES	
Basemen	CORR L07	1100	0	110	Corridor	0	0	0	0.06	1100	66	YES	
Basemen	CUST L31	337	3	45	Storage	5	2	1	0.06	337	24	YES	
Basemen	HEAD END L19	110	1	20	Storage	5	2	0	0.06	110	8	YES	
Basemen	MEDIA L18A	514	4	80	Office	5	5	3	0.06	514	44	YES	
Basemen	OFFICE L23	320	3	45	Office	5	5	2	0.06	320	27	YES	
Basemen	READING RM L21	3110	63	945	Libraries	5	10	31	0.12	3110	529	YES	
Basemen	STORAGE L32	303	0	45	Storage	5	2	1	0.06	303	21	YES	
Basemen	SCIENCE L01	1205	30	450	Class	10	35	42	0.12	1205	566	NO	116.35