Technical Report 3

Mechanical Systems
Existing Conditions
Evaluation

Glen Burnie High School: Buildings D, E & F Glen Burnie, MD

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11/29/2010

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Executive Summary

Glen Burnie High School is a campus style high school located in Glen Burnie, MD. The campus is comprised of 6 buildings, but for the purposes of this report, only Buildings D, E & F were evaluated. Building D is a constant air volume system served by unit ventilators, with fan coil units and cabinet unit heaters providing supplemental heating and cooling in corridors, stairways and storage areas. Building E is a constant air volume system served by 9 air handling units with convectors and cabinet unit heaters again serving as supplemental heat. There is also an individual unit ventilator serving the gymnastics area. Building F is the only variable air volume system of the three buildings and is served by 4 air handling units and 1 roof top unit. In the same manner as the previous 2 buildings, fan coil units and unit heaters are used for extra heating and cooling. Chilled water is supplied to Buildings D & F by chillers located in Building A. Building E is served by its own chiller. Heating water is supplied to all three buildings by steam boilers located in Building F.

The mechanical renovation that is currently under way was required to increase performance and efficiency over the existing system by replacing equipment and installing new equipment for additional services. The largest factors influencing design were the ability to have equipment fit in place of the existing equipment and maintain compatibility with equipment that was remaining and existing energy sources. The buildings receive gas and electric from Baltimore Gas & Electric, but there is the potential to use on-site renewable energy in the form of geothermal.

The actual annual energy use for the building is not available for comparison but the energy use was calculated for this report. Based on the findings, the energy usage appears to be reasonable for buildings of this size. Overall energy use for the three buildings combined is 5,117,270 kBTU/year. The largest energy consumer is the heating system, followed by lighting.

The mechanical renovation to the buildings was also evaluated for LEED credits. Because there is some information that is not available for this report, some credits could not be evaluated. The credit which pertains to percentage of on-site renewable energy was not obtained at this point, but with the possibility of geothermal energy as a source for the buildings, several points for this credit have the potential of being obtained. Another way to gain more credit would be to install CO_2 sensors in the densely occupied spaces of the buildings.

Overall, the operation of the building's mechanical system adequately meets the required standards. There is the opportunity for renewable energy to be explored at the risk of increasing the cost of the renovation. LEED was not taken into consideration for this renovation, however with a few simple steps more credits could be obtained.

Introduction

Glen Burnie High School is an existing campus style high school located in Glen Burnie, MD. It is a 6 building campus but this report will only consider the 3 buildings which are directly affected by the mechanical renovation. Building D is a typical classroom building housing the arts and acting arts classrooms, as well as a handful of foreign language classrooms. In addition to classrooms, there are a few faculty planning and conference rooms located around the building. The primary school gymnasium is located in Building E. This building also contains locker rooms, a weight room and a gymnastics area. The most diverse of the 3 buildings is Building F which contains the auxiliary gym and locker rooms on the east end of the building and business education classrooms filling the rest.

Design Objectives & Requirements

Because Glen Burnie High School was already constructed and in use, the purpose of the renovation was to upgrade some of the equipment and overall performance of the existing mechanical system. This created the need to maintain compatibility of the new equipment with the current. There were other restrictions to the mechanical design that resulted from this project being a renovation. Since there was a system already in place, the energy sources which were in use before the renovation were favored to reduce the cost of switching to a new source. The selection of equipment was further limited because of dimensional requirements caused by existing mechanical spaces.

Existing Conditions

Energy Sources and Rates:

Baltimore Gas & Electric is the supplier of natural gas and electricity to the Glen Burnie High School campus. Below are tables listing the rates and rate schedules for BG&E.

Baltimore Gas & Electric Rates					
Electricity				Gas	
Demand Charge	Peak	Mid-Peak	Off-Peak	≤10000 therms	>10,000 therms
($/kW)	(¢/kWh)	(¢/kWh)	(¢/kWh)	($/therm)	($/therm)
3.95	11.551	9.265	8.824	0.1975	0.0948

Table 1: Baltimore Gas & Electric Rates

BG&E Rate Schedule		
Start	**End**	**Rate**
11:00 PM	7:00 AM	Off-Peak
7:00 AM	10:00 AM	Mid-Peak
10:00 AM	8:00 PM	Peak
8:00 PM	11:00 PM	Mid-Peak

Table 2: BG&E Rate Schedule

In addition to natural gas and electricity, there is the possibility to utilize geothermal energy for the campus based on the available land space. This could be utilized from the land occupied by the baseball and football fields. However, cost needs to be considered, as well as construction times, as installation would interrupt the sports seasons.

Annual Energy Use:

Actual annual energy use information is not available for Glen Burnie High School. The annual energy use was calculated for this report based on the heating and cooling loads calculated earlier, but no comparison was done since there is no existing information. The energy usage for the buildings appears to be reasonable. Overall energy use for the three buildings is 5,117,270 kBTU/year with the heating system being the largest energy consumer, followed by lighting.

ENERGY CONSUMPTION SUMMARY
By ACADEMIC

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1					
Primary heating					
Primary heating		973,361	68.4 %	973,361	1,024,590
Other Htg Accessories	6,011		1.4 %	20,514	61,548
Heating Subtotal	**6,011**	**973,361**	**69.8 %**	**993,875**	**1,086,138**
Primary cooling					
Cooling Compressor	33,352		8.0 %	113,830	341,523
Tower/Cond Fans	4,219		1.0 %	14,400	43,204
Condenser Pump			0.0 %	0	0
Other Clg Accessories	298		0.1 %	1,017	3,052
Cooling Subtotal....	**37,869**		**9.1 %**	**129,247**	**387,778**
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps			0.0 %	0	0
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....			0.0 %	0	0
Lighting					
Lighting	69,748		16.7 %	238,049	714,218
Receptacle					
Receptacles	18,196		4.4 %	62,104	186,332
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	**131,824**	**973,361**	**100.0 %**	**1,423,274**	**2,374,466**

Figure 1: Building D Energy Consumption Summary

ENERGY CONSUMPTION SUMMARY
By ACADEMIC

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1					
Primary heating					
Primary heating		1,033,694	73.1 %	1,033,694	1,088,099
Other Htg Accessories	6,556		1.6 %	22,374	67,130
Heating Subtotal	**6,556**	**1,033,694**	**74.7 %**	**1,056,069**	**1,155,229**
Primary cooling					
Cooling Compressor	44,541		10.8 %	152,018	456,098
Tower/Cond Fans	6,093		1.5 %	20,794	62,390
Condenser Pump			0.0 %	0	0
Other Clg Accessories	410		0.1 %	1,398	4,194
Cooling Subtotal....	**51,043**		**12.3 %**	**174,210**	**522,682**
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps			0.0 %	0	0
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....			0.0 %	0	0
Lighting					
Lighting	52,390		12.6 %	178,806	536,471
Receptacle					
Receptacles	1,548		0.4 %	5,284	15,855
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	**111,537**	**1,033,694**	**100.0 %**	**1,414,369**	**2,230,237**

Figure 2: Building E Energy Consumption Summary

ENERGY CONSUMPTION SUMMARY
By ACADEMIC

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1					
Primary heating					
Primary heating		1,665,839	73.1 %	1,665,839	1,753,515
Other Htg Accessories	11,440		1.7 %	39,044	117,145
Heating Subtotal	**11,440**	**1,665,839**	**74.8 %**	**1,704,883**	**1,870,659**
Primary cooling					
Cooling Compressor	17,852		2.7 %	60,928	182,802
Tower/Cond Fans	2,867		0.4 %	9,785	29,357
Condenser Pump			0.0 %	0	0
Other Clg Accessories	301		0.1 %	1,029	3,086
Cooling Subtotal....	**21,020**		**3.2 %**	**71,741**	**215,245**
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps			0.0 %	0	0
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....			0.0 %	0	0
Lighting					
Lighting	112,916		16.9 %	385,381	1,156,258
Receptacle					
Receptacles	34,463		5.2 %	117,621	352,899
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	**179,838**	**1,665,839**	**100.0 %**	**2,279,627**	**3,595,062**

Figure 3: Building F Energy Consumption Summary

Mechanical System Design Parameters

Design Air Conditions:

Glen Burnie High School was designed based on the outdoor air conditions stated in ASHRAE Fundamentals 2005 for Baltimore, MD. Indoor air conditions were selected based on standard practice and existing conditions for the buildings. The following table shows these design conditions.

Design Air Conditions					
Outdoor Design Conditions			Indoor Design Conditions		
Summer		Winter	Cooling	Heating	Relative Humidity
DB (F)	MCWB (F)	DB (F)	DB (F)	DB (F)	%
93.9	74.9	12.9	78	72	50

Table 3: Design Air Conditions

Ventilation Requirements:

New ventilation rates were calculated for the renovation to ensure that the buildings would still meet or exceed the outdoor air requirements. In addition, a second set of ventilation rates were calculated for this report for a basis of comparison.

Outdoor Airflow Rates		
Building/System	Design OA (CFM)	Report Calculated OA (CFM)
Building D/UVs	9700	10483
Building E/AHU-1	2000	480
Building E/AHU-2	2800	1344
Building E/AHU-3	2000	510
Building E/AHU-4 & 5	6000	2765
Building E/AHU-6	2500	28
Building E/AHU-7	350	137
Building E/AHU-8	100	110
Building E/AHU-9	1300	518
Building F/AHU-1	5600	5799
Building F/AHU-2	5850	5608
Building F/AHU-3 & 4	2140	2261
Building F/AHU-5	950	391

Table 4: Outdoor Airflow Rates

The variance between the two airflow requirements is very minimal with only a few systems being designed to less than calculated. It can then be reasonably determined that the cause is due to the assumptions that were made during the calculations. All assumptions for occupancy were made based on the type of room, instead of the actual occupancies that occur in the building as these are not known.

The only large discrepancy is from the systems serving Building D. The likely reason for the shortage stems from combining all of the systems into one large system for the calculations that were performed for this report. This was done to simplify the calculations since the building's system is comprised of several unit ventilators which are located in nearly every room in the building. Doing this caused the critical system to effect the required OA of all of the systems, when in fact, each system is critical only to itself.

Design Heating and Cooling Loads:

The heating and cooling loads were calculated for the renovation using Trane Trace. For comparison purposes, the loads were recalculated for this report using Trane Trace as well in order to reduce discrepancies caused by different programs.

Building D Load Comparisons				
Zone	Cooling SF/ton		Heating BTUh/SF	
	Design	Model	Design	Model
1st Floor	397.51	498.97	22.95	30.01
2nd Floor	317.84	389.77	27.07	33.2
3rd Floor	229.37	309.05	33.32	40.07

Table 5: Building D Load Comparisons

Building E Load Comparisons				
Zone	Cooling SF/ton		Heating BTUh/SF	
	Design	Model	Design	Model
AHU-1	217.72	449.64	56.84	34.77
AHU-2	184.93	218.45	51.99	65.94
AHU-3	219.69	385.33	52.75	32.24
AHU-4 AHU-5	133.78	109.22	75.61	42.84
AHU-6	37.72	42.07	101.71	81.38
AHU-7	245.33	341.47	50.44	17.73
AHU-8	257.85	527.02	51.46	23.15
AHU-9	246.15	396.77	47.37	29.16
UV-1	221.3	361.47	64.11	41.46
CUH & CONV	--	--	57.11	23.28

Table 6: Building E Load Comparisons

Building F Load Comparisons				
Zone	Cooling SF/ton		Heating BTUh/SF	
	Design	Model	Design	Model
AHU-1	307.09	384.94	19.01	16.01
AHU-2	231.38	324.88	31.19	37.07
AHU-3 AHU-4	284.16	170.81	36.67	49.1
RTU-1	238.81	254.07	42.05	41.76
FCU-1	272.53	203.89	31.63	37.69
FCU-2	322.94	236.63	34.41	34.43
UH	--	--	8.99	17.51

Table 7: Building F Load Comparisons

As anticipated, there were differences between the design loads and those calculated for this report. This can be attributed to the ways in which the models were created. The designer's model was created on a room by room basis, while this report dealt with a block load. There were also differences in the load assumptions. For this report, in order to obtain a more accurate model the default climate design values in Trace were replaced with values from ASHRAE Fundamentals. Lighting, miscellaneous, and people loads were also set up for different room types, instead of using a default value for all spaces. However, the designer was able to use more accurate information for room occupancy and other equipment loads from the actual buildings.

The heating and cooling loads for all three buildings are generally smaller than designed, except for Building D's heating load which is larger. This makes sense since the model created for this report was a block load compared to a room by room model for the design, but the rest of the heating loads for the other buildings as well as the cooling loads should also be larger. Because they are not, it must be assumed that the actual load conditions in the buildings are larger than were assumed for the recalculation.

Mechanical System Overview

Building D:

Building D's heating and cooling is supplied by 35 unit ventilators, 8 fan coil units, and 21 cabinet unit heaters. Unit ventilators are primarily located in classroom locations with the fan coil units serving the faculty areas and corridors. Supplemental heating is supplied to the corridors, stairwells and storage rooms by the cabinet unit heaters.

Chilled water is supplied to the building from chillers located in Building A. Unfortunately, since this building is not directly a part of the renovation, information could not be obtained. Hot water for the building is supplied by steam boilers located in Building F.

Building E:

Heating and cooling is supplied to the building by 9 constant air volume air handling units, 9 hot water convectors, 3 cabinet unit heaters and a single unit ventilator. As part of the renovation a new chiller was installed to supply chilled water to Building E. It will be located outside of Building E in a separate chiller enclosure. Hot water for the building is supplied by steam boilers located in Building F.

Building F:

Building F is the only variable air volume system of the 3 buildings. Heating and cooling is supplied by 4 air handling units, 1 roof top unit, 2 fan coil units and 17 unit heaters. Chilled water for the building is supplied by the same chillers as Building D. Again, due to Building A not being a part of the renovation, information for the chillers could not be obtained. Hot water is once again supplied by the same steam boilers that serve buildings D and E.

Major Equipment Breakdown:

The mechanical renovation to Glen Burnie High School consisted of the replacement of terminal equipment, such as unit ventilators and fan coil units, as well as larger equipment. A chiller was added to Building E and a reheat boiler was added to Building F's VAV system. In order to conserve energy, energy recovery ventilating units were added to Building E. The following tables list and briefly describe all of the major equipment that will be installed as a part of this renovation.

Building D Equipment List				
Unit Ventilators	**CFM**	**Cooling (MBH)**	**Heating (MBH)**	**Quantity**
UV-1	750	20	19.3	4
UV-2	1000	27.6	35.9	7
UV-3	1150	36.4	43.3	2
UV-4	1250	35.8	51.6	6
UV-5	1500	38.4	53.8	16
Cabinet Unit Heaters	**CFM**	**HP**	**Heating (MBH)**	**Quantity**
CUH-1	230	1/15	12.7	14
CUH-2	335	1/15	17.7	2
CUH-3	430	1/10	23.2	5
Fan Coil Units	**CFM**	**Cooling (MBH)**	**Heating (MBH)**	**Quantity**
FCU-1	200	15.2	2.8	5
FCU-2	430	7.1	1	1
FCU-3	560	9.2	1	2
Exhaust Fans	**CFM**	**Static (IN W.G.)**	**RPM**	**Quantity**
EF-1	200	0.3	1550	1
EF-2	300	0.25	1550	2
EF-3	350	0.35	1300	1
EF-4	550	0.3	1550	1
EF-5	650	0.3	1140	1
EF-6	1040	0.35	860	1
EF-7	1500	0.35	1725	1
EF-8	1925	0.35	1725	1
Pumps	**GPM**	**Head (FT H2O)**	**RPM**	**Quantity**
CHW	207	40	1150	2
HW	226	55	1750	2
Heat Exchangers	**GPM**	**Steam (lb/hr)**	**Type**	**Quantity**
HX-1	226	2265	Shell & Tube	1

Table 8: Building D Equipment List

Building E Equipment List				
Chillers	**GPM**	**Capactiy (tons)**	**EER**	**Quantity**
CH-1	370	140.8	9.8	1
Air Handling Units	**CFM**	**Cooling (MBH)**	**Heating (MBH)**	**Quantity**
AHU-1	900	31.3	30.9	1
AHU-2	1300	56.4	56.6	1
AHU-3	1300	113.3	110.1	1
AHU-4	2000	165.6	162.7	2
AHU-5	2500	213.2	250.5	1
AHU-6	2800	234.7	228.8	1
AHU-7	7200	404.4	352.1	2
Unit Ventilators	**CFM**	**Cooling (MBH)**	**Heating (MBH)**	**Quantity**
UV-1	2000	55.3	109.2	1
Cabinet Unit Heaters	**CFM**	**HP**	**Heating (MBH)**	**Quantity**
CUH-1	345	1/10	21	1
CUH-2	505	1/10	29.2	2
Convectors	**GPM**	**Mounting**	**Heating (MBH)**	**Quantity**
CONV -1	0.9	Surface	9	4
CONV -2	1.1	Surface	11	3
CONV -3	1.2	Recessed	12	2
Exhaust Fans	**CFM**	**Static (IN W.G.)**	**RPM**	**Quantity**
EF-1	800	0.25	1725	1
EF-2	1400	0.5	1725	1
Pumps	**GPM**	**Head (FT H2O)**	**RPM**	**Quantity**
CHW	309	60	1750	2
HW	186.5	40	1750	2
Glycol	370	60	1750	2
Heat Exchangers	**GPM**	**Steam (lb/hr)**	**Type**	**Quantity**
HX-1	309/370	--	Plate & Frame	1
HX-2	2000	187	Shell & Tube	1
Energy Recovery Ventilator	**CFM**	**Exhaust CFM**	**Summer/Winter Eff (%)**	**Quantity**
ERV-1	2000	1900	.58/.59	2
ERV-2	2800	2700	.58/.59	1

Table 9: Building E Equipment List

Building F Equipment List				
Boilers	**GPM**	**Input (MBH)**	**Output (MBH)**	**Quantity**
B-1	45	725	500	1
Air Handling Units	**CFM**	**Cooling (MBH)**	**Heating (MBH)**	**Quantity**
AHU-1	17300	526	560.5	1
AHU-2	15300	734	565.3	1
AHU-3	5250	228	144.9	2
RTU-1	2360	87.6	121.5	1
Fan Coil Units	**CFM**	**Cooling (MBH)**	**Heating (MBH)**	**Quantity**
FCU-1	1624	41.2	46.8	2
Unit Heaters	**CFM**	**HP**	**Heating (MBH)**	**Quantity**
UH-1	400	1/12	1.2	15
UH-2	800	1/7	6.4	2
Exhaust Fans	**CFM**	**Static (IN W.G.)**	**RPM**	**Quantity**
EF-1	350	0.25	1050	1
EF-2	1900	0.75	1140	1
EF-3	200	0.25	1550	1
EF-4	410	0.4	1300	1
EF-5	400	0.25	1550	2
EF-6	1710	0.75	1725	1
EF-7	850	0.5	1140	1
EF-8	970	0.25	1140	2
EF-9	100	0.25	1550	3
EF-10	1600	0.5	1140	1
EF-11	70	0.25	1550	1
EF-12	3000	0.5	1725	1
EF-13	1200	0.5	1725	1
EF-14	15100	1	1725	1
EF-15	12500	1	1725	1
Pumps	**GPM**	**Head (FT H2O)**	**RPM**	**Quantity**
CHW	349	50	1750	2
HW	340.5	55	1750	2
Reheat	72.5	45	1750	2
A-F CHW	1100	120	1750	2
FTR	42	60	3450	2
Heat Exchangers	**GPM**	**Steam (lb/hr)**	**Type**	**Quantity**
HX-1	340.5	3410	Shell & Tube	1

Table 10: Building F Equipment List

System Schematics:

The following figures show the piping schematics for the chilled and heating water plants. Because there are differences in the delivery methods, the schematics for each distribution type were drawn. Buildings D & F share the same chilled water plant, while Building E has its own. For heating water, all three buildings use the same boilers, but there is an added reheat boiler for Building F's terminal boxes in the VAV system.

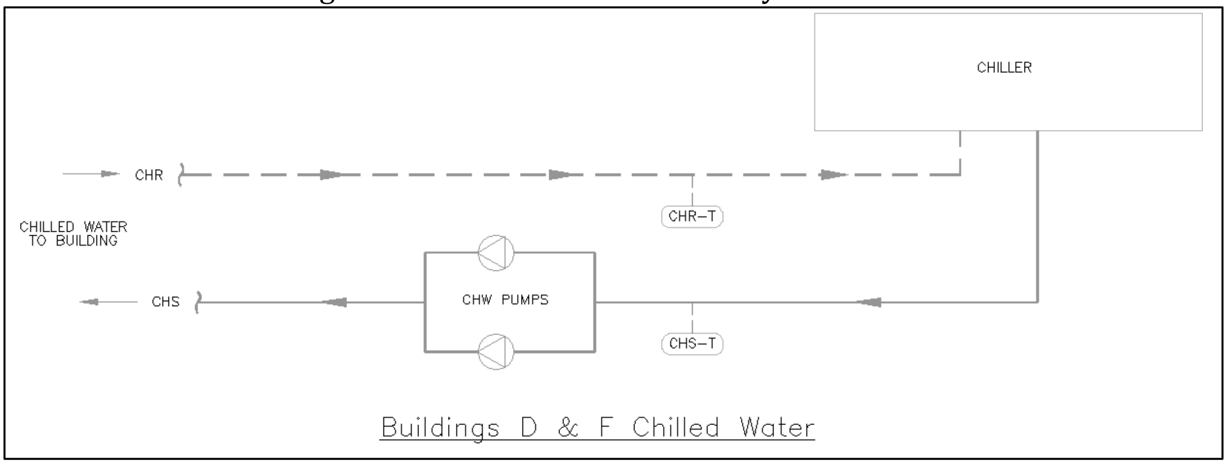

Figure 4: Buildings D & F Chilled Water

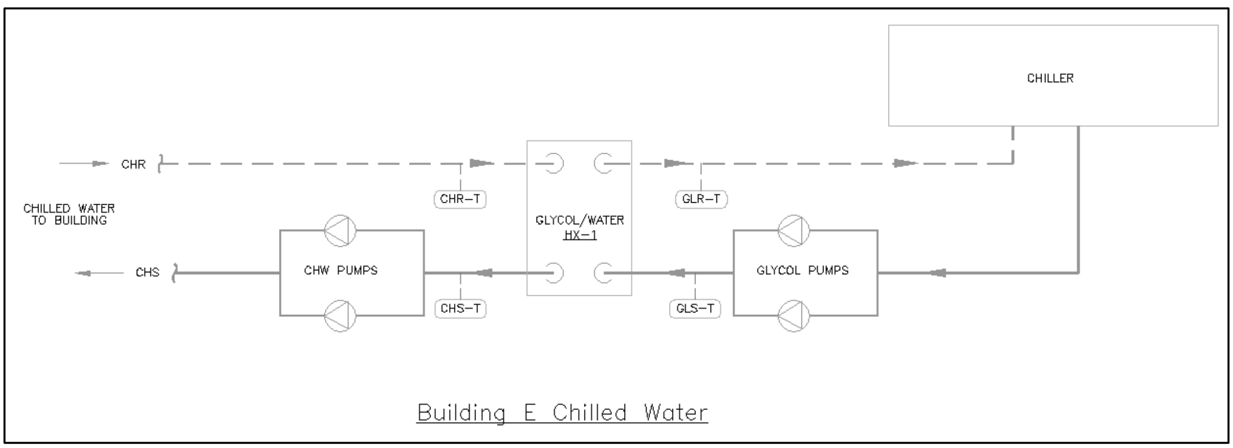

Figure 5: Building E Chilled Water

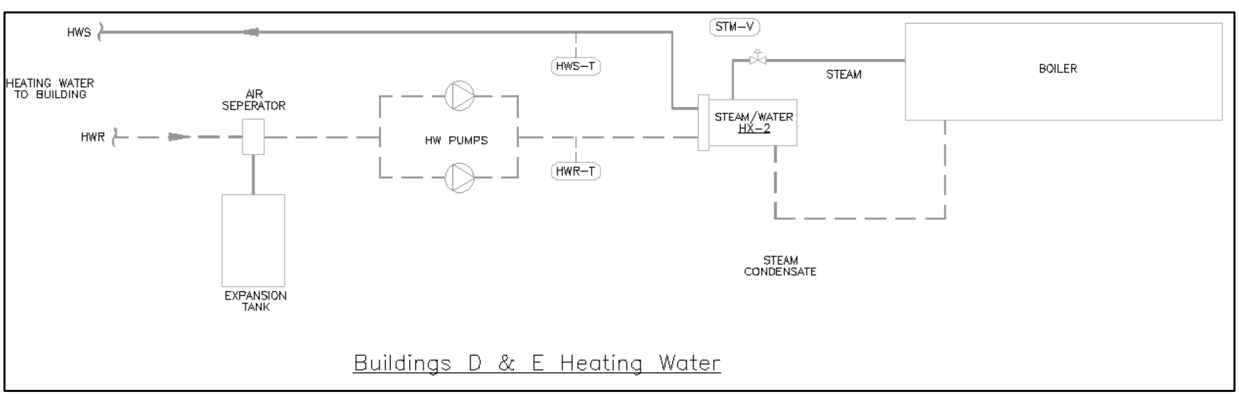

Figure 6: Buildings D & E Heating Water

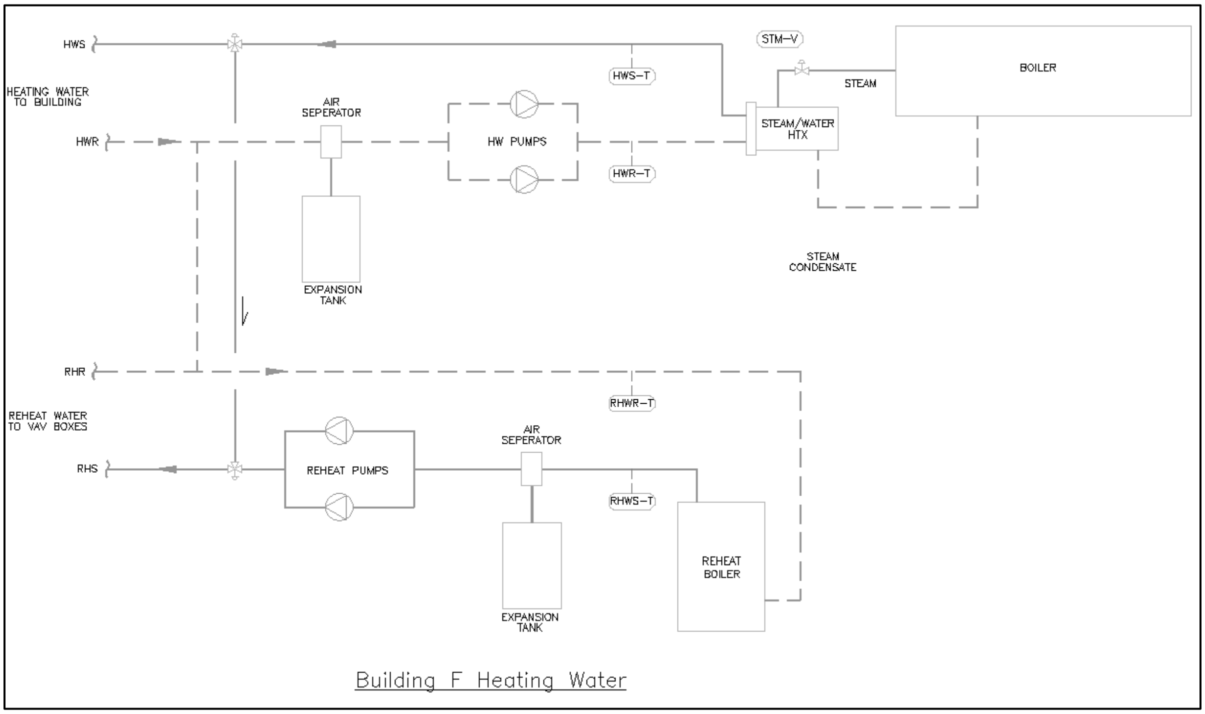

Figure 7: Building F Heating Water

System Operation:

Chilled Water:

Buildings D & F have the same operation for their chilled water systems. Chillers in Building A supplied chilled water to both buildings. When the outdoor air temperature is above the setpoint and there is a demand for cooling based on the thermostat readings, the chiller is activated. The chilled water pumps are then enabled and operate in a lead/lag fashion. The lag pump is only operational when the lead pump fails to energize. The lead/lag designations operate according to schedule and are adjustable to balance wear on pumps. Temperature of the chilled water is maintained in the chiller and is checked by the chilled water supply and return temperature sensors.

Building E has similar operation, but with more intricate operation with the installation of the new chiller and heat exchanger. When the outdoor air temperature is above the setpoint, the chiller is activated. Activation of the chiller energizes the chilled water and glycol pumps in lead/lag operation. Again, the lag pump is only operational when the lead pump fails to energize and designation is adjustable. Heat is then transferred inside the heat exchanger between the glycol solution and chilled water. Temperatures are monitored by the glycol and chilled water supply and return temperature sensors, and the glycol solution temperature is maintained inside the chiller.

Heating Water:

All three buildings have the same operation for heating water. Boilers in Building F are energized when the outdoor air temperature is below the setpoint and there is a demand for heating in the buildings based on thermostat readings. The heating water pumps are energized and deliver the heating water to the load. The pumps operate in a lead/lag fashion with the lag pump only operational when the lead pump fails to energize. The lead/lag designations operate according to schedule and are adjustable to balance wear on pumps. A steam/water heat exchanger transfers heat between the steam generated in the boilers and the heating water delivered to the load. A steam valve is modulated based on the required amount of steam needed to satisfy the load.

Building F has an additional part to the heating water system since it is the only VAV system. When in cooling mode and there is a call for reheat the reheat boiler is energized. This energizes the reheat pumps which operate in lead/lag fashion with the lag pump only operating when the lead pump fails to energize. The temperature of the reheat water is checked by the supply and return reheat water temperature sensors and maintained in the reheat boiler.

Mechanical System Impact

Lost Usable Space:

This renovation was able to result in a gain of usable space. This was possible because the new terminal equipment was selected to match the replaced equipment in both size and location. Aside from the replacement of smaller equipment such as unit ventilators and fan coil units, the majority of new work was the replacement of piping. This was installed in order to use the same space occupied by the original piping, resulting in no lost space again. The only major changes in equipment came in on of the mechanical room areas of Building E. Three small AHU's and two larger heating units were removed and three new AHU's were installed. This resulted in the gain of approximately 100 square feet of usable space.

Mechanical System First Cost:

The estimated cost of the mechanical renovation is $6,000,000. With a total square footage of approximately 110,000 square feet, this works out to approximately $54.55 per square foot.

Leed Credits:

Energy & Atmosphere:

EA Prerequisite 1: Fundamental commissioning must take place for this credit. Because commissioning is due to take place, this credit is awarded.

EA Prerequisite 2: A whole building energy use simulation must show a 5% improvement over the existing building. Since actual energy use information is not available, this will be assumed to be compliant.

EA Prerequisite 3: No CFC-based refrigerants are to be used in the HVAC systems. The renovation complies by not using this type of refrigerant.

EA Credit 1: Points are awarded based on the amount of improvement in energy use for the renovated building over the existing building. Without the existing energy use information, this cannot be calculated.

EA Credit 2: Points are awarded based on the percent of on-site renewable energy that is used in the systems. At this time, that percentage is 0. But there is the possibility to utilize renewable energy on-site.

EA Credit 3: Enhanced commissioning above and beyond that which is performed for EA Prerequisite 1. There was no contract set up for this type of commissioning to take place.

EA Credit 4: R-134a is the only refrigerant used, so based on the following assumptions: equipment life of 25 years, leakage rate of 0.5% annually, end of life loss of 2%, and a charge of 2 lbm/ton the impact of the equipment is 15.08. Since this is less than the maximum of 100 the credit is awarded.

EA Credit 5: It was not known/attainable whether there is an extended plan to keep track of energy use by the building other than standard utility bills.

EA Credit 6: There is no plan for green power use with Glen Burnie High School at this time.

Indoor Environmental Quality:

IEQ Prerequisite 1: Building must meet the minimum ventilation requirements of ASHRAE Standard 62.1. The mechanical renovation meets this requirement.

IEQ Prerequisite 2: Prevent or minimize the amount of environmental tobacco smoke in the building. Glen Burnie High School is a non-smoking building.

IEQ Credit 1: CO_2 sensors are required in all densely populated spaces for this credit to be given, since this is not satisfied the credit is not awarded.

IEQ Credit 2: For this credit, ventilation rates need to be increased by 30% above the baseline for all occupied spaces. The majority of occupied spaces satisfy this requirement, but because all do not, the credit cannot be given.

IEQ Credit 3: Credit 3.1 calls for plans during construction to keep indoor air quality at acceptable levels. Credit 3.2 calls for plans after construction to keep indoor air quality at acceptable levels. This renovation is lasting through the school year, so storage of materials is already placed in areas that will not affect the IAQ of the buildings, and after major milestones of the renovation a system flush-out occurs. So both points can be awarded.

IEQ Credit 6.2: For this credit, 50% of the building occupants must have control over their thermal comfort. Operable windows are an acceptable substitute for thermostats or equipment controls. This credit is satisfied by thermostats, operable windows, and equipment controls throughout the buildings.

IEQ Credit 7: Credit 7.1 calls for the design of the HVAC system to meet ASHRAE Standard 55 for thermal comfort of occupants. Credit 7.2 is the verification that the design is working properly. Credit 7.1 is achieved so a point is awarded. Credit 7.2 is yet to be determined because it is unknown whether there will be a verification process to determine compliance with Standard 55.

Conclusion

The mechanical renovation to Glen Burnie High School successfully met the challenge of replacing the original equipment while maintaining compatibility with existing equipment and energy sources and not reducing usable space. By replacing and combining units there was a surplus of usable space in the mechanical rooms of 100 square feet. Overall, the operation of the building's mechanical system adequately meets the required standards of supplying the heating and cooling needs to the buildings and maintaining occupant comfort and controllability. There is the opportunity for renewable energy to be explored as an option to reduce the energy usage of the buildings, effectively reducing utility costs, but this comes with the risk of increasing the cost of the renovation. While LEED was not taken into consideration for this renovation, with a few simple steps several credits could be obtained toward certification for the campus.

References

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Bid Documents and Project Specifications for Glen Burnie High School Buildings D, E & F

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