Mechanical Technical Report 2

Building and Plant Energy Analysis Report

Lutheran Theological Seminary at Philadelphia
The New Learning Center

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October 26, 2007

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Executive Summary

The Lutheran Theological Seminary at Philadelphia, The New Learning Center is located in the code district of Philadelphia, Pennsylvania. ASHRAE 90.1 has requirements for building envelope, HVAC systems and equipment, and electrical systems that must be met. ASHRAE also specifies the design conditions for the modeling and simulation of the building before construction. Analysis was performed of the building and its systems to compare with the ASHRAE 90.1 codes. The results are shown in the following table.

Category	System or Design Compliance
Exterior Walls	Yes
Roof	Yes
Glass Area	Yes
Glass U-Value	Yes
Glass Shading Coefficient	No
Chiller COP	Yes
Boiler COP	Yes
Service Water Heating	Yes
Power	Yes
Lighting	No
Motor Efficiency	Yes

LEED-NC Certification was also performed on the Lutheran Theological Seminary at Philadelphia. Although this building was not initially designed for LEED purposes, it was designed well enough that 15 points were still attained. If the design and construction were up to date with the most recent building strategies and codes it would be above that level. With slight variation to the process and design another 15 points would be attainable. That would make the building LEED Certified, and almost LEED Silver.

The Lutheran Theological Seminary at Philadelphia was designed with a mechanical system with a chiller, two boilers, three air handling units, and fan coils for heating and cooling. With these pieces of equipment, and all the supporting mechanical equipment that allows the system to operate properly, the total initial HVAC cost was $1,468,000. That breaks down to approximately $26.22 per square foot. There is also an overall 3.57% of the building area that in lost rentable space due to the mechanical room, mechanical closets for fan coils units, and vertical shafts for ductwork.

Trane Trace was used to model the building and run load, energy, and cost estimations. All of the zones and equipment were input into the program and run. The analysis showed that all portions of the system, including the boilers, chiller, air handling units, and fan coils, were all

sized properly for heating and cooling. Some of the air handling unit ventilation values were slightly low, but they were quite close to the calculated values. The simulation estimated the annual cost of operation of the mechanical and electrical systems to be $77,168, approximately $1.38 per square foot.

LEED-NC Certification

LEED-NC Certification is a measuring tool us by the USGBC (US Green Building Council) to evaluate the level of sustainability and green design of each building. LEED stands for Leadership in Energy and Environmental Design. The new certification checklist is LEED-NC Version 2.2. The rating system has different categories which aim to conserve sites, water, energy, materials and resources, and improve the indoor environment. There are 6 different categories used to delegate green building points. Each of the categories has basic requirements which must be met before any of the points in the category can be achieved.

The LEED checklist delegates the appropriate points for each building and totals them up to compare the performance of the building to a measuring stick. This measuring stick is based on a scale of 69 possible points. There are four different levels of LEED certification. The requirements for each level are as follows:

Certified: 26-32 points
Silver: 33-38 points
Gold: 39-51 points
Platinum: 52-69 points

The Lutheran Theological Seminary at Philadelphia was not designed with the intent to be a LEED certified building. There were several LEED points awarded after construction, but many more would have been easily achieved. With the new design methods, construction methods, and codes of the present time, many more could have been easily achieved. With little or no alteration to the building, it would have been possible to add many LEED points to the overall rating of the building if it was considered early on in the design process. The present results of the building are shown in the following table.

	Total Awarded Points	Certification Rating
Points Awarded as Designed	15	None
Points Easily Attainable	30	Certified

Points that were considered easily attainable were points that would require slight planning, up to date design or construction processes, codes that must be passed that also meet point criteria, and have little or no building alteration or cost. Sustainable Sites was the category that could have easily benefitted the most by slight alterations. With just the installation of shower heads in the bathrooms, marking of parking spaces, changing the color of the roof, and using more environmentally favorable exterior fixtures, four additional points could be awarded. One more could also be awarded since Philadelphia now requires storm water tanks as part of the design in all buildings. Many other points could be awarded if the building was commissioned soon after construction and an energy management system installed. Many of the Material and Resources points also could have been awarded if the design team planned accordingly.

Overall this building does not have any LEED certification. That, however, does not mean that it was not designed to be helpful to the environment. The breakdown of points shows that with little planning the Lutheran Theological Seminary at Philadelphia New Learning Center could have easily been certified. More planning and work would have had to been done to have the building reach a silver, gold, or platinum level.

HVAC System Compliance with ASHRAE 90.1

ASHRAE 90.1 provides minimum performances and codes for HVAC systems and individual units. For requirements to be met, all parts of the mechanical system for the Lutheran Theological Seminary at Philadelphia must comply with these codes. In this section, some of the analysis that must be done is of the chiller, boilers, motors, and service water heating.

The chiller is an air cooled absorption chiller with single effect. According to AHRAE 90.1, all sizes of this chiller must have a COP of 0.60. After the calculations were made, this chiller had a COP of 2.76. The calculations and work for this can be found in Appendix B. Since the chiller greatly exceeds ASHRAE, it was a good choice to provide the cooling for the building's HVAC system.

The Lutheran Theological Seminary at Philadelphia has two boilers that provide the heating capability. Both boilers are the same size and are slightly oversized for future expansion. For Gas-Fired boiler greater than 225,000 Btuh, the efficiency must be at least 80%. The analysis showed that the installed boilers were exactly 80% efficient. The calculations can be seen in Appendix B. These boilers meet the minimum efficiency and are a proper selection for the Lutheran Theological Seminary at Philadelphia.

Through inspection, all motors also comply with minimum efficiency specified by ASHRAE 90.1. ASHRAE also says that the service water heating system must have a minimum of 1" insulation throughout. This system meets minimum requirements as well.

All of this analysis shows that the HVAC system meets requirements set by ASHRAE 90.1. The systems in the building were designed and installed properly and should function correctly. There were no problems meeting any code.

Building Envelope Compliance with ASHRAE 90.1

ASHRAE 90.1 provides minimum requirements that the building envelope must meet. The insulation of the walls, floors, and roof can be determined by using ASHRAE Fundamentals. Compliance must be determined by staying below a maximum U-value (transmittance value) or above a minimum R-Value (insulation value). The glazing of the building must also be taken into account. The glass needs to have a minimum percentage of wall area, U-value, and shading coefficient. All of this information is evaluated by the design documents.

The summary of the walls, floors, and roof is summarized in the following table. All portions of the exterior meet ASHRAE 90.1.

Envelope	ASHRAE 90.1 Max U Value	Designed U Value	Complies?
Roof	0.065	0.055	Yes
Exterior Walls Above Grade	0.124	0.09075	Yes
Exterior Walls Below Grade	1.14	0.12443	Yes
Slab on Grade	0.73	0.21261	Yes

ASHRAE 90.1 states that the maximum fenestration of a building is 50% of vertical facing walls. It also states that the maximum skylight exposure is 5%. The Lutheran Theological Seminary at Philadelphia does not have any skylights, so this requirement is met. Through calculations, the glazing of the vertical exterior walls is 15%, therefore it complies. After that, the energy transmission and shading coefficient of the windows must meet the requirements. These will be evaluated in the category of 10-20% fenestration. The results can be seen in the following table. The Minimum U-value is met but the shading coefficient comes up just short.

Envelope	ASHRAE 90.1 Max Value	Designed Value	Complies?
Fenestration U Value @ 15%	0.57	0.5	Yes
Fenestration SHGC @ 15%	0.39	0.55	No

Power and Lighting Compliance with ASHRAE 90.1

ASHRAE 90.1 has requirements that must be met by the power and lighting systems in the Lutheran Theological Seminary at Philadelphia. ASHRAE requires certain rules, energy saving methods, and safety factors that must be taken into account when designing the electrical systems in the building. While the building envelope and mechanical systems were based on energy savings and efficiency, the Power and Lighting requirements are more based on design methods.

The power requirements focus on the sizing of feeders and branch circuits. Both have a maximum voltage drop that can occur within the electrical system. ASHRAE states the feeders must have a maximum voltage drop of 2% at design load. It also says voltage drop of branch circuits at design load must remain below 3%. All of these requirements were taken into consideration during design, and therefore pass code. The power system was designed appropriately.

AHSRAE 90.1 has requirements on what the maximum watts per square foot can be used in a building for lighting. There are two approaches that can be used to verify the compliance. The first method is the watts that can be used when the overall building is evaluated by watts per square foot defined by the general building use. The allowance is then compared to the design of the building's lighting system. The more detailed analysis allows the same method to be performed on a zone by zone basis. A function is given to each zone, and all of the allowances by zone are summed up to make a total building allowance. This value is usually more forgiving and can sometimes allow the building to pass code when the overall building method would not. In this report the more detailed room specific method was used. The results are shown in the following table.

Floor	Designed Power	ASHRAE Max Power	Complies?
Basement	14016	9829.6	
First Floor	17944	15958.3	
Second Floor	19994	13315.1	
Third Floor	20813	13711.9	
Total	72767	52814.9	**No**

The lighting system of the Lutheran Theological Seminary at Philadelphia does not comply with the requirement of ASHRAE 90.1. Lighting codes due to the conservation of energy and light pollution have become stricter in recent years. All city and ASHRAE codes were met at the time of the design.

Mechanical System Initial Cost and Lost Rentable Space

The Lutheran Theological Seminary at Philadelphia is equipped with a mechanical system for heating, ventilating, and air conditioning. The system contains several main components. The pieces of equipment that would consist of a large amount of the initial cost are the two gas-fired boilers, the air cooled absorption chiller, and the 66 fan coils units equipped with hydronic heating and cooling coils. Smaller portions of the cost would be the unit heaters, split systems, fans, and pumps necessary to operate the system correctly. The system first cost was approximately $1,468,000. When broken down the system's approximately value was $26.22 per square foot.

The mechanical system in the building has an initial cost, but also a cost due to the lost rentable space. In the HVAC system, there are alterations that had to occur to conventional design due to the lack of space between floors. Because of this lack of plenum room, closets were required to house the fan coil units, which cuts into the usable space of the Lutheran Theological Seminary at Philadelphia. Other factors that cut into the space were the vertical shafts running between floors and the mechanical room in the basement. The detailed breakdown of areas can be found in Appendix A. The summary of lost rentable space is presented in the following table.

Floor	Lost Area	Total Area	% Area Lost
Basement	1423	12022	11.84
First Floor	203	15860	1.28
Second Floor	175	13681	1.28
Third Floor	184	14034	1.31
Total Building	1985	55597	3.57

Clearly most of the lost rentable space is in the basement. This is not as important since the rest of the basement is used for nothing but storage. A greater percentage of the upper floors being lost would be much more inconvenient for the owner, since it would cut into the office and learning spaces.

Design Load Calculations

To design and estimate loads for the Lutheran Theological Seminary at Philadelphia, The New Learning Center, the building needed to be modeled in a building energy simulation program. The program used for the analysis of this report was Trane Trace. The majority of the input data was taken from AHSRAE 90.1. ASHRAE gives the outdoor design conditions, lighting watts per square foot depending on function of the room, sensible load from people, and values of the building envelope. Occupancies for the rooms, schedules of room use, and sensible loads from equipment were taken from the design documents. All of the rooms, windows, exteriors, and other values were entered into the program. All of the rooms were then assigned to the proper system, and then the system assigned to the proper plants.

Upon further inspection, the air handlers were designed conservatively compared to the values given in the simulation. There was more than enough cooling capacity in the air handlers and the fan coils which they serve to cool the zones properly. The ventilation air quantity per square foot is the only place that the designed air handing units fell short of the simulated building. This is not an extremely large problem since all of the zones passed the minimum requirements of ASHRAE 62.1. The results for the cooling and ventilating of the three air handlers and plenum are shown in the following tables.

RTU-1 and Fan Coils

	Designed Load	Computed Load
Area	13970	13970
Cooling sf/ton	172.83	266.88
Supply Air cfm/sf	1.25	1.15
Ventilation Supply cfm/sf	0.45	0.46

RTU-2 and Fan Coils

	Designed Load	Computed Load
Area	15723	15723
Cooling sf/ton	244.87	337.69
Supply Air cfm/sf	0.79	0.88
Ventilation Supply cfm/sf	0.39	0.43

RTU-3 and Fan Coils

	Designed Load	Computed Load
Area	6947	6947
Cooling sf/ton	252.80	388.64
Supply Air cfm/sf	1.18	0.78
Ventilation Supply cfm/sf	0.24	0.32

Plenum and Fan Coils

	Designed Load	Computed Load
Area	11755	11755
Cooling sf/ton	524.39	636.36
Supply Air cfm/sf	0.64	0.46
Ventilation Supply cfm/sf	0.14	0.22

The next thing that had to be examined was the capacity of the heating and cooling plants. The peak loads of the systems were determined to properly size the chiller for cooling and the boilers for heating. Upon review the chiller was sized almost perfectly for the given building simulation. The two boilers together had more capacity that was needed for the heating of the building. This is due to the fact that the boilers were purposely oversized to be used in heating the future neighboring library as well. The results showing that the equipment is sized properly are in the flowing tables.

Boilers

	Designed Load MBH	Computed Load MBH
Boilers (2)	1800	1648

Chiller

	Designed Load Tons	Computed Load Tons
Chiller	150	147

This analysis shows that all of the mechanical equipment was designed to meet peak load. There is enough capacity from all major HVAC components to allow this building to function correctly. Extra information about loads and schedules are in Appendix C.

Energy Consumption and Operation Costs

To estimate the yearly energy consumption, operation costs, and emissions, Trane Trace is used to model and simulate the performance of the Lutheran Theological Seminary at Philadelphia. This energy data was based upon the input values from the design loads for the building. All of the mechanical systems, units, and efficiencies were input to make the model as realistic as possible.

The cost of energy was estimated due to the fact that the exact billing information was not made available. Energy companies have varying cost of energy structures, so the information was estimated and simplified for this analysis. The price of the estimated energy is shown in the following table.

	Cost of Energy
Gas	$0.92 / therm
Electric	$0.13 / kWh
Demand	$8.65 / kW

The Lutheran Theological Seminary at Philadelphia requires not only an electric feed, but also gas for the boilers and the roof top units. At times it is good to have two feeds of energy, like in cases when the cost of one type of energy increases vastly. This allows the bills to stay slightly steadier. The problem is that when the cost of one type of energy decreases quickly, the benefits cannot be seen as much. The following table shows the breakdown of how much of each energy source is used per year to operate the building.

Source	Electric kWh	Gas therms	% of Total Energy
Primary Heating	9,038.5	15,388.5	45.0%
Primary Cooling	60,350.3		5.9%
Fans and Pumps	335,730.5		32.8%
Lighting	166,922.7		16.3%
Total	572,042.0	15,388.5	100.0%

As shown in the table, therms is a significantly larger quantity of measure than kWh, greater by approximately ten times. This is the reason for a significantly larger portion of energy consumed by the heating sources than by the cooling. The fact that the building is in a colder climate in Philadelphia, rather than somewhere in the southern United States, also plays a great role in the sizing and energy use.

An extensive energy analysis was not done during the design process for the Lutheran Theological Seminary at Philadelphia. There was no need for simulation since the owner and engineer knew what system they wanted to implement ahead of time. The system for The New Learning Center ties in very well with the neighboring buildings and other buildings on the campus.

Although the energy consumption is good information to have during the design process, there is another reason that the building model is simulated. When performance of a structure is analyzed, it is possible to also figure out the yearly emissions from the operation of the building. Usually the emissions information is broken down into four categories, CO_2, SO_2, NOx, and particulates. The amount of yearly emissions of these pollutants is shown in the following table.

Pollutant	Emissions lbm / year
CO_2	1,001,358
SO_2	4,315
NO_x	2,942
Particulates	367

The yearly operation is not only simulated to figure out the amount of energy and the emissions, but also to simulate the annual cost for the owner. With the knowledge of energy consumption per year, where in the system it is consumed, and the cost per energy unit, it is possible to figure out the cost of each piece of equipment. The cost of operation is modeled after the percentage of energy that is consumed by each of the system components per year. That is the reason for the operation of the heating equipment being the most expensive, while the cooling equipment is the least. The cost breakdown is shown in the following table.

	Calculated Cost of Operation
Boilers	$34,725.60
Chiller	$4,552.91
Fans / Pumps	$25,311.10
Lights	$12,578.38
Building Operation per Year	$77,168.00
Building Operation per sf	$1.38

Some systems are more energy efficient than others. With the modeling and simulation of a building before design, the engineer can more easily assess what would be the correct system for each building if the construction and initial cost permits. Not only is saving energy good for the environment, it also reduces the amount of emissions and saves the owner money on energy bills for the life cycle of the building. As always though, the most energy efficient system and best design is quite often turned down due to the larger initial cost. One type of building that would usually be willing to pay more for the initial cost of mechanical equipment is a building like this, which the builder will also be the owner until the building is demolished. This is one reason that energy was saved by design methods like the heat recovery wheels installed in the air handling units.

Appendix A

LEED for New Construction v2.2
Registered Project Checklist

Project Name: LTSP
Project Address: Philadelphia, PA

Yes	?	No			
5	5	4		**Sustainable Sites**	**14** Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
		1	Credit 1	**Site Selection**	1
1			Credit 2	**Development Density & Community Connectivity**	1
1			Credit 3	**Brownfield Redevelopment**	1
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
	1		Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
	1		Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel-Efficient Vehicles	1
1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
1			Credit 5.1	**Site Development,** Protect or Restore Habitat	1
		1	Credit 5.2	**Site Development,** Maximize Open Space	1
	1		Credit 6.1	**Stormwater Design,** Quantity Control	1
		1	Credit 6.2	**Stormwater Design,** Quality Control	1
		1	Credit 7.1	**Heat Island Effect,** Non-Roof	1
	1		Credit 7.2	**Heat Island Effect,** Roof	1
	1		Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
1	1	3		**Water Efficiency**	**5** Points
	1		Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
		1	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		1	Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
		1	Credit 3.2	**Water Use Reduction**, 30% Reduction	1

1	3	13		**Energy & Atmosphere**	**17** Points
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required

***Note for EAc1**: All LEED for New Construction projects registered after June 26th, 2007 are required to achieve at least two (2) points under EAc1.

1	1	8	Credit 1	**Optimize Energy Performance**	1 to 10

Yes	?	No	Credit	Description	Points
				1 10.5% New Buildings or 3.5% Existing Building Renovations	1
				14% New Buildings or 7% Existing Building Renovations	2
				17.5% New Buildings or 10.5% Existing Building Renovations	3
				21% New Buildings or 14% Existing Building Renovations	4
				24.5% New Buildings or 17.5% Existing Building Renovations	5
				28% New Buildings or 21% Existing Building Renovations	6
				31.5% New Buildings or 24.5% Existing Building Renovations	7
				35% New Buildings or 28% Existing Building Renovations	8
				38.5% New Buildings or 31.5% Existing Building Renovations	9
				42% New Buildings or 35% Existing Building Renovations	10
		3	Credit 2	**On-Site Renewable Energy**	1 to 3
				2.5% Renewable Energy	1
				7.5% Renewable Energy	2
				12.5% Renewable Energy	3
		1	Credit 3	**Enhanced Commissioning**	1
		1	Credit 4	**Enhanced Refrigerant Management**	1
	1		Credit 5	**Measurement & Verification**	1
	1		Credit 6	**Green Power**	1

continued…

Yes	?	No		Materials & Resources	13 Points
1	3	9			
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		1	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
		1	Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1
		1	Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
	1		Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
		1	Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
1			Credit 3.1	**Materials Reuse**, 5%	1
		1	Credit 3.2	**Materials Reuse**,10%	1
	1		Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
		1	Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
	1		Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1
		1	Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1
		1	Credit 6	**Rapidly Renewable Materials**	1
		1	Credit 7	**Certified Wood**	1

Yes	?	No		Indoor Environmental Quality	15 Points
5	3	7			
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
	1		Credit 1	**Outdoor Air Delivery Monitoring**	1
1			Credit 2	**Increased Ventilation**	1
	1		Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
	1		Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1

Yes	?	No	Credit	Description	Points
		1	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
		1	Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
		1	Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
		1	Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Lighting	1
		1	Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1			Credit 7.1	**Thermal Comfort**, Design	1
		1	Credit 7.2	**Thermal Comfort**, Verification	1
1			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
		1	Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No		
2		3	**Innovation & Design Process**	**5** Points

Yes	?	No	Credit	Description	Points
1			Credit 1.1	**Innovation in Design**: Provide Specific Title	1
		1	Credit 1.2	**Innovation in Design**: Provide Specific Title	1
		1	Credit 1.3	**Innovation in Design**: Provide Specific Title	1
		1	Credit 1.4	**Innovation in Design**: Provide Specific Title	1
1			Credit 2	**LEED® Accredited Professional**	1

Yes	?	No		
15	15	39	**Project Totals (pre-certification estimates)**	**69** Points

Certified: 26-32 points, **Silver:** 33-38 points, **Gold:** 39-51 points, **Platinum:** 52-69 points

Appendix B

Chiller COP

COP = Cooling Effect / Energy Input

Cooling Effect = 150 tons = 527.4 kW

Input = 12.73 kW/ton * 150 tons = 190.95

COP = 527.4 kW / 190.95 kW = 2.76

Boiler COP

Boiler Efficiency = Gross Output / Gross Input

Gross Input = 1800 MBH

Gross Output = 1440 MBH

Boiler Efficiency = 1440 MBH / 1800 MBH = .80 = 80%

LTSP WINDOW AREA

Room	Window SF
Basement	0
First Floor	2386
Second Floor	1033
Third Floor	1324
Total Window Area	4743
Total Vertical Wall Area	32623.5
% Fenestration	15%

Appendix C

LTSP LOST RENTABLE SPACE DUE TO MECHANICAL SYSTEM

Basement

Room	Label	Lost Area	Total Area	% Area Lost
Mechanical Room	B05	1338		
Mechanical Fan Coil Closet	B07D	85		
Total		1423	12022	11.8

First Floor

Room	Label	Lost Area	Total Area	% Area Lost
Mechanical Fan Coil Closet	102B	72		
Mechanical Fan Coil Closet	103B	38		
Mechanical Fan Coil Closet	103C	38		
Mechanical Fan Coil Closet	103F	55		
Total		203	15860	1.3

Second Floor

Room	Label	Lost Area	Total Area	% Area Lost
Mechanical Fan Coil Closet	205A	19		
Mechanical Fan Coil Closet	205B	37		
Mechanical Fan Coil Closet	205D	38		
Mechanical Fan Coil Closet	209B	62		
Mechanical Fan Coil Closet	225A	19		
Total		175	13681	1.3

Third Floor

Room	Label	Lost Area	Total Area	% Area Lost
Mechanical Fan Coil Closet	305A	19		
Mechanical Fan Coil Closet	305B	40		
Mechanical Fan Coil Closet	305E	19		
Mechanical Fan Coil Closet	309B	64		
Mechanical Fan Coil Closet	312C	19		
Mechanical Fan Coil Closet	312D	23		

Total	184	14034	1.3

Total Building

Floor	Label	Lost Area	Total Area	% Area Lost
Basement	B	1423	12022	11.84
First Floor	1	203	15860	1.28
Second Floor	2	175	13681	1.28
Third Floor	3	184	14034	1.31
Total Building		1985	55597	3.57

LTSP SCHEDULES

Office

Function	Hour	% of Usage	Function	Hour	% of Usage
Lights	1	0	People	1	0
	2	0		2	0
	3	0		3	0
	4	0		4	0
	5	0		5	0
	6	0		6	0
	7	10		7	0
	8	50		8	30
	9	100		9	100
	10	100		10	100
	11	100		11	100
	12	100		12	100
	13	100		13	100
	14	100		14	100
	15	100		15	100
	16	100		16	100
	17	100		17	100
	18	50		18	30
	19	10		19	10
	20	0		20	0
	21	0		21	0
	22	0		22	0
	23	0		23	0
	24	0		24	0

School

Function	Hour	% of Usage	Function	Hour	% of Usage
Lights	1	5	People	1	0
	2	5		2	0
	3	5		3	0
	4	5		4	0
	5	5		5	0
	6	5		6	0
	7	10		7	0
	8	10		8	10
	9	80		9	100
	10	90		10	100
	11	90		11	100
	12	90		12	80
	13	40		13	20
	14	90		14	100
	15	90		15	100
	16	55		16	30
	17	5		17	0
	18	5		18	0
	19	5		19	0
	20	5		20	0
	21	30		21	0
	22	5		22	0
	23	5		23	0
	24	5		24	0

LTSP Load Sources

Source	Sensible Load Btuh
People	250
Personal Computer	1000
Printer	5000
Coffee Maker	3000
Computer Server	3000
Kitchen Eq	As Specified

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