LONGWOOD AT OAKMONT HEALTHCARE CENTER

VERONA, PENNSYLVANIA

TECHNICAL ASSIGNMENT II

BUILDING AND PLANT ENERGY ANALYSIS REPORT

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The Pennsylvania State University
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Mechanical Option
Senior Thesis

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EXECUTIVE SUMMARY

The Longwood at Oakmont Healthcare Center is roughly a 50,000 square foot building located in Verona, Pennsylvania. The building's heating, ventilating, and air-conditioning systems were analyzed in reference to different energy conscious and sustainable standards, such as ASHRAE Standard 90.1 and LEED-NC Version 2.2. The building's loads and energy estimates were also computed and studied.

Multiple building elements were investigated and determined compliant or not with regard to ASHRAE Standard 90.1. A summarized list of findings is provided below:

	Building Envelope			**Mechanical Systems & Equipment**					**Lighting**	**Motors**
	Wall R-Value	Roof R-Value	Glass U-Value	Heat Pump COP/EER	Boiler Efficiency	Cooling Tower	Energy Recovery Unit Efficiency	Mechanical Insulation	Lighting	Motor Efficiency
RESULT	Complies	Complies	Complies	Complies	Complies	Does Not Comply	Complies	Complies	Does Not Comply	N/A

The building's environmental foot print was further looked into using the LEED-NC Green Building Rating System. In order to achieve LEED certification a building must obtain at least 26 points. The Healthcare Center, while still not under construction, is in line to receive 22 points. With a little extra effort, planning, and financing the building could become LEED certified.

The initial cost of the building's mechanical system is $1,875,088 or roughly $33 per square foot. The mechanical equipment also takes up space that could otherwise be used as rentable space. This space sums up to about 3000 square feet or almost 7% of the buildings total footprint.

Finally the building's loads and energy consumption were assessed using HVAC modeling software (Trane Trace and Elite). The results showed that the building's air flow was pretty similar to that of the designed quantities. The annual cost of operation was estimated to be $275,000.

MECHANICAL SYSTEMS INITIAL COST

The Longwood at Oakmont Healthcare Center's mechanical system is comprised of mainly an energy recovery unit with an integrated energy wheel, a 250 ton fluid cooler, three gas-fired boilers, two end-suction variable speed pumps, and roughly 100 water source heat pumps. Such equipment as the energy recovery unit has a great potential in saving energy costs, but also has a greater initial cost.

The initial cost estimates of the mechanical system were provided by Reese Engineering Inc. The actual bid values were asked to be withheld upon request of the owner.

Mechanical Systems Initial Cost	$1,875,088
Mechanical Systems Initial Cost per Sq. Ft.	$33.02/ft^2

MECHANICAL SYSTEMS LOST RENTABLE SPACE

The Longwood at Oakmont Healthcare Center contains a multilevel area as well as a single story level. The building footprint is just under 50,000 square feet with 45,000 square feet of that being usable space. The mechanical systems of the building occupy a portion of that usable space by means of shafts, heat pump closets, and a large mechanical room located on the second floor. In total the mechanical system takes up roughly 7% of the building's rentable space. Below is a more detailed breakdown of the lost usable space due to mechanical system components.

	Mechanical Room	Heat Pump Closets	Shafts	**Total**
Floor Area (ft^2)	2430	516	128	**3074**
% of Usable Space	5.3	1.1	0.3	**6.8**

LEED-NC VERSION 2.2 CERTIFICATION

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a practice used to evaluate buildings and assess their compliance with a number of sustainable design points. It was created by the United States Green Building Council (USGBC) and has grown quite popular over the past few years. The main goal of the system is to make a positive impact on public health and the environment, reduce operating costs, enhance building and organizational marketability, and possibly increase occupant productivity (LEED 2005).

There are four different levels of LEED certification that Longwood at Oakmont Healthcare Center could possibly achieve. The following outlines the requirements for such levels:

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

The Longwood at Oakmont Healthcare Center was not intended to achieve any sort of LEED certification, but due to standard efficient and energy conscious practices of the engineers and architects on board for the project the building could be eligible for LEED certification. The following illustrates a summarized point distribution:

	Sustainable Sites	Water Efficiency	Energy & Atmosphere	Materials & Resources	Indoor Environmental Quality	Innovation & Design Process	Total
Probable Points	5	2	-	4	11	-	22
Possible Points	-	-	7	2	3	-	12
Improbable Points	9	3	10	7	1	5	35

If all of the following probable points are achieved and a few of the possible points are also achieved the building could attain LEED certification. However, a lot of these points depend highly on the contractor and the construction process. Points such as Construction Waste Management, Regional Materials, and Construction IAQ Management are planned to be obtained but things could change during the course of construction. Certain points, like Measurement and Verification, and Thermal Comfort (verification) are also planned to occur once construction is completed and are therefore assumed to be possible points.

Some points were overlooked, although somewhat easy to obtain, like Commissioning, due to the owner's initial budget concerns.

The Longwood at Oakmont Healthcare Center is somewhat of a testament to how popular LEED and sustainable design practices are becoming. By taking the right steps to achieve all the points listed above, this building can reach LEED certification levels without having the goal to do so. It shows that certain players in the industry are adopting "green" practices whether or not there is an acknowledgement that comes along with it.

A detailed break down of individual LEED points is provided in the Appendix B.

BUILDING ENVELOPE COMPLIANCE WITH ASHRAE 90.1

Checking compliance with section 5 of ASHRAE Standard 90.1 was done using the Prescriptive Building Envelope Option. This was capable because the Longwood at Oakmont Healthcare Center amount of total vertical fenestration is less than 50% of the gross wall area and there are no skylights located within the building. Verification of this is located below:

Total Vertical Glass Area	Total Wall Area	% Total Vertical Fenestration Area
4146 Ft^2	15461 Ft^2	27 %

The Longwood at Oakmont Healthcare Center is located in Verona, Pennsylvania which falls into climate zone 5-A. This was determined by using Table B-1 in Appendix B of ASHRAE Standard 90.1. Due to this climate designation Table 5.5-5 was used to check building envelope requirements. The following tables exemplify the buildings compliance with building envelope standards:

	Roof (Attic)	Wall 1 (Mass)	Wall 2 (Wood Framed)	Slab-On-Grade Floors (Unheated)
Minimum Required R-Value (ASHRAE 90.1)	R-30	R-7.6	R-13	N/A
Specified	R-38	R-18.6	R-26.3	N/A
Compliance	Yes	Yes	Yes	N/A

Vertical Fenestration	Assembly Max U (Fixed)	Assembly Max SHGC (All Orientations)
Required (ASHRAE 90.1)	0.57	0.39
Specified	0.34	0.38
Compliance	Yes	Yes

All R-values, U-values, and SHGC were either obtained from design documents from Reese Engineering Inc. or from specifications written by RLPS Architects Ltd. As shown from the tables the Longwood at Oakmont Healthcare Center is in full compliance with ASHRAE Standard 90.1 for an energy efficient building envelope.

POWER & LIGHTING COMPLIANCE WITH ASHRAE 90.1

POWER (SECTION 8)

In Section 8 of ASHRAE Standard 90.1 power distribution standards are established for buildings. There are two mandatory provisions called out in this section. One provision is that feeder conductors are sized for a maximum voltage drop of 2% at design load. The other is that branch circuit conductors shall be sized for a maximum voltage drop of 3% at design load. The Longwood at Oakmont Healthcare Center's electrical system was designed to meet these voltage drop stipulations and therefore complies with ASHRAE 90.1 Section 8.

LIGHTING (SECTION 9)

Lighting power allowances for buildings are set up in Section 9 of ASHRAE Standard 90.1. Two methods are laid out to determine such allowances. One method is the Building Area Method which is a simplified method computing the wattage allowed for a zoned space on a square foot basis. The other method is the Space-by-Space method which is a more detailed approach and allows for individual space occupancy/function to be accounted for while computing the wattage allowance. For the analysis of the Longwood at Oakmont Healthcare Center the Building Area Method was used. The building's spaces were broken down into the following categories: Dormitory (for resident rooms), Office, Health-Care Clinic, and Dining: Family. All spaces, with the exception of the dining area, have equal power density levels and were therefore grouped together for easier calculation. All necessary values, constants, and lighting information were collected from the design drawings and Table 9.5.1 of ASHRAE 90.1. The Longwood at Oakmont Healthcare Center was not in compliance with ASHRAE 90.1 Section 9. A main reason for the excessive watt consumption was due to architectural track lighting located in accentuated public spaces. It contributed to nearly 40% of the overall lighting wattage. A detailed breakdown of this information can be found in the Appendix C.

	Total Used Watts	Power Density (W/ft^2)	Floor Area (ft^2)	Allowed Watts	Compliance
Dining Space	6230	1.6	4152	6643.2	YES
General Space	82872	1	40848	40848	NO

HVAC SYSTEMS COMPLIANCE WITH ASHRAE 90.1

EQUIPMENT EFFICIENCY

In ASHRAE 90.1 Section 6 efficiency requirements are instituted for mechanical systems and equipment. They are set up in order to minimize the amount of energy required to properly operate the building. Because the Longwood at Oakmont Healthcare Center is greater than 25,000 square feet the Mandatory Provisions portion of Section 6 was used to determine its compliance. Tables 6.8.1(A-J) provide a thorough description of all necessary provisions and requirements for different mechanical components. A summarized list of equipment is provided below:

Equipment	Efficiency Value	Required	Installed	Compliance	Table or Standard
HP-1	COP EER	4.2 11.2	4.7 13.5	YES YES	6.8.1B 6.8.1B
HP-2	COP EER	4.2 11.2	4.3 12.1	YES YES	6.8.1B 6.8.1B
HP-3	COP EER	4.2 11.2	4.6 13.3	YES YES	6.8.1B 6.8.1B
HP-4	COP EER	4.2 12	4.6 13.3	YES YES	6.8.1B 6.8.1B
HP-5	COP EER	4.2 12	4.3 12	YES YES	6.8.1B 6.8.1B
HP-6	COP EER	4.2 12	4.3 12	YES YES	6.8.1B 6.8.1B
HP-7	COP EER	4.2 12	4.2 12	YES YES	6.8.1B 6.8.1B
HP-8	COP EER	4.2 12	4.3 13.1	YES YES	6.8.1B 6.8.1B
HP-9	COP EER	4.2 12	4.4 12.6	YES YES	6.8.1B 6.8.1B
HP-10	COP EER	4.2 12	4.3 12.8	YES YES	6.8.1B 6.8.1B
HP-11	COP EER	4.2 12	4.3 13	YES YES	6.8.1B 6.8.1B
Boilers	%	75	85	YES	6.8.1F
Cooling Tower	gpm/hp	38.2	30.5	NO	6.8.1G
Energy Recovery Unit	%	50	58	YES	6.5.6.1

DUCT AND PIPE INSULATION

ASHRAE Standard 90.1 Section 6 lays out a number of requirements for duct and pipe insulation in an effort to minimize the amount of heat loss and heat gain. They base their insulation requirements off of the American Society for Testing and Materials (ASTM) standards. The Longwood at Oakmont Healthcare Center specifies that all duct and pipe insulation comply with these ASTM criteria. As a result the building's HVAC insulation is in compliance with ASHRAE 90.1.

SERVICE WATER HEATING

In ASHRAE 90.1 Section 7 water heating performance benchmarks are set up. Similar to Section 6, a descriptive outline of equipment standards and requirements is provided (Table 7.8). The Longwood at Oakmont Healthcare Center utilizes four gas storage water heaters for their domestic water system. Per Section 7 each water heater is to have a thermal efficiency of at least 80%. Each water heater used in the building has a thermal efficiency of 84%, obtained from equipment selection cut-sheets provided by the engineer, and therefore complies with ASHRAE Standard 90.1.

ELECTRIC MOTOR EFFICIENCY

Section 10 of ASHRAE Standard 90.1 sets up a table illustrating the efficiency requirements for different motors. The Longwood at Oakmont Healthcare Center employs two main fans inside the energy recovery. A supply fan of 20 hp and an exhaust fan of 15hp are used to move air throughout the building. Due to lack of other vital manufacturer's data on the fan motors proper efficiency calculations could not be performed. Compliance with ASHRAE 90.1 is, as of now, unknown regarding Section 10.

DESIGN LOAD ESTIMATION

The Longwood at Oakmont Healthcare Center was analyzed using Elite to determine the demand load. Building information such as outside air ventilation rates, building occupancy, lights (on a per square foot basis), equipment loads (from ASHRAE Fundamentals, Chapter 29, Table 5 and building plans), and building envelope construction (taken from specifications and design documents) was used to estimate the total demand for the building.

The outdoor design conditions were also taken into consideration while computing the design load. These conditions were found in the ASHRAE Handbook of Fundamentals. The conditions used for this analysis were based off of Pittsburgh, PA with a dry bulb temperature of 90°F and a wet bulb temperature of 71°F. For heating conditions temperatures of 4°F and 3°F, dry bulb and wet bulb respectively, were used. This information, along with the interior loads and building characteristics, inputted into Elite and then computed to acquire a total design load of the building.

Design Load Summary

	Design Supply Air (cfm/ft2)	Calculated Supply Air (cfm/ft2)	Ventilation Air (cfm/ft^2)	Design Load (ft^2/ton)	Calculated Load (ft^2/ton)
Heat Pump Sum	1.17	1.31		413	551
Energy Recovery Unit			0.29		

The results illustrate somewhat close similarities between designed and calculated values. The calculated values are a little higher than that of the designed values. One possible reason for this could simply be a lack of thorough knowledge of the simulation software (Elite).

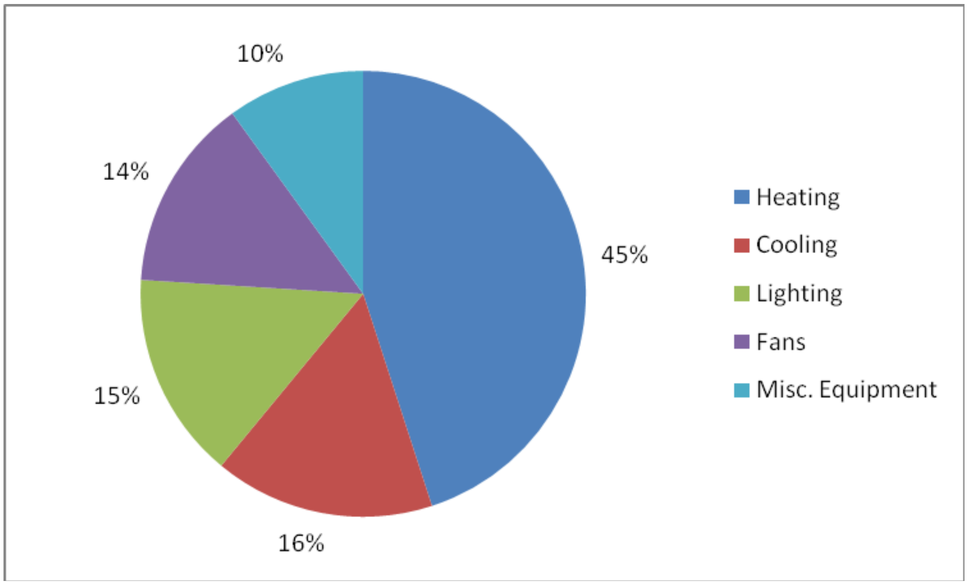
Located in Appendix A is a table of equipment and lighting schedules which was used to more closely estimate the true load demand.

ANNAUL ENERGY CONSUMPTION AND OPERATING COSTS

To analyze the Longwood at Oakmont Healthcare Center's energy consumption and operating costs Trane Trace 700 was used. The same information that was used to calculate the building's demand load was also used to analyze the energy usage. The necessary information either came from design data, provided by Reese Engineering, or from previously calculated values from earlier in this report. Because the building is not yet constructed utility rates could not be obtained. However, utility rates were obtained for similar buildings within the campus of Longwood at Oakmont and were used in the analysis of the Healthcare Center. These rates are listed below.

Energy Generation (0-20000 kWh): $0.0727/kWh
Energy Generation (>20000kWh): $0.0304/kWh
Energy Transmission: $0.0035/kWh
Energy Distribution (0-20000 kWh): $0.0179/kWh
Energy Distribution (>20000kWh): $0.0055/kWh
Natural Gas: $1.31/therm

Multiple elements contribute to the building's energy consumption and the below graphic illustrates a breakdown of such elements:



Based on the Trace input data and the utility rates given by the owner an overall annual energy cost was estimated for the building. It costs $275,115 dollars a year to operate the Longwood at Oakmont Healthcare Center, which is equivalent to $6.11 per square foot. This value seems surprisingly high as well does the amount of energy it takes for the heating portion of the building's energy consumption. After multiple attempts to eradicate the problem little was resolved. One main hurdle while performing this analysis was thoroughly understanding the modeling software (Elite and Trace).

During the design of the Longwood at Oakmont Healthcare Center there was no energy analysis performed by the hired engineers. There were multiple reasons for not performing such an analysis. The main players on board for this project, architect, MEP engineer, and contractor, all possess a great deal of expertise and experience on such Continuing Care Retirement Community (CRCC) buildings and the type of systems that are most economical to build and operate. A few main systems, mechanically speaking, were presented to the owner based on previous experience, location of the project, the capability of the Owner's Facility Group, and historical construction costs. The systems options were spelled out to the owner along with pricing narratives, provided by the contractor, and then one such option was selected by the owner, based on cost and effectiveness. In today's demanding building industry energy studies are most frequently performed on projects looking to achieve LEED certification, projects with large central plants, and/or projects located in dense cities where utility rates tend to be higher. The Longwood at Oakmont Healthcare Center was neither of the aforementioned.

REFERENCES

"ANSI/ASHRAE Standard 90.1-2007 – Ventilation for Acceptable Indoor Air Quality." ASHRAE, Inc. Atlanta, GA. 2007.

"Additions and Renovations to Health Center for Presbyterian Seniorcare – Longwood at Oakmont." Plans and schedules. Reese, Lower, Patrick, and Scott, Ltd. September 2007.

"LEED-NC: Green Building Rating System for New Construction and Major Renovations – Version 2.2." U.S. Green Building Council. October 2005.

APPENDIX A – Operating Profiles

Operating Profiles

	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	12am
1	25	25	25	35	45	65	95	C	C	C	C	C	C	C	C	C	C	C	C	90	85	65	55	35
2	25	25	25	25	25	50	C	C	C	C	C	C	C	C	C	C	C	C	C	85	75	50	35	25
3	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
4	0	0	0	0	0	0	C	C	C	C	C	C	C	C	C	C	C	C	0	0	0	0	0	0

The following table is an hourly break down of the building's functional use by percentage of full load. "C" is considered full load. Profile 1 represents the lighting load, profile 2 represents the equipment load, and profile 3 represents the occupant load, which is always occupied.

APPENDIX B - LEED FOR NEW CONSTRUCTION PROJECT CHECKLIST

Yes	?	No			
5		9	**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			
2		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

	7	10	**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.

	5	5	Credit 1	**Optimize Energy Performance**	1 to 10
				10.5% New Buildings or 3.5% Existing Building Renovations	1

Yes	?	No		Description	Points
				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			
4	2	7		**Materials & Resources**	13 Points
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

Yes	?	No	Credit	Description	Points
	1		Credit 7	**Certified Wood**	1

Yes	?	No			
11	3	1		**Indoor Environmental Quality**	15 Points
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
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			
		5		**Innovation & Design Process**	5 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		
22	12	35	**Project Totals (pre-certification estimates)**	69 Points

APPENDIX C – Lighting Loads (General Spaces)

Lighting Fixture	Quantity or Linear Feet	W/Fixture or W/LF	Watts
A1	24	81	1944
A2	18	81	1458
A3	6	135	810
A4	4	81	324
A5	2	54	108
B1	9	27	243
C1	0	50	0
D1	21	81	1701
F1	5	20	100
F2	6	27	162
F3	4	12	48
G1	9	64	576
G2	29	64	1856
G3	30	30	900
G4	23	25	575
H1	872	16	13952
H2	216	16	3456
H3	6	16	96
J1	157	52	8164
J2	2	52	104
J3	38	26	988
J4	125	52	6500
J5	1	52	52
J6	4	75	300
J7	35	75	2625
J8	3	32	96
K1	32	10	320
L1	33	96	3168
L2	18	96	1728
L3	18	100	1800
L4	4	50	200
M1	10	84	840
M2	2	83	166
N1	2	27	54
EC	1	27	27
ED	22	27	594
EE	3	27	81
EF	8	20	160
UA1	956	16	15296
UB1	42	81	3402
UB2	14	54	756
UC1	38	81	3078
UF1	41	27	1107
UE1	36	0.49	17.64
UG1	84	35	2940
TOTAL			**82872.64**

Appendix C cont. – Lighting Loads (Dining Spaces)

Lighting Fixture	Quantity or Linear Feet	W/Fixture or W/LF	Watts
A1	11	18	198
A3	3	135	405
B1	9	27	243
C1	12	50	600
F1	7	20	140
G3	7	30	210
H1	102	16	1632
J1	4	52	208
J4	35	52	1820
J5	12	52	624
J6	2	75	150
TOTAL			**6230**