DASCO Medical Office Building

Saint Joseph Medical Center

Towson, Maryland

Mechanical Technical Report 2

Building and Plant Energy Analysis Report

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Mechanical Option

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Executive Summary

Technical Report 2 is an analysis of the DASCO Medical Office Building and plant energy usage. It is a goal of this report to model the HVAC systems in the building using an energy model program. Carrier's Hourly Analysis Program (HAP) was the program used to model the DASCO building. Also, as part of this report, the United States Green Building Council's Leadership in Energy and Environmental Design (LEED) building performance rating system was used to determine the sustainability and green design aspects of this building. LEED for New Construction Version 2.2 was the checklist used to evaluate this project.

It is also important, when analyzing a building's energy consumption, to check the compliance with ASHRAE Standard 90.1. The latest version of this standard was released in 2004, and details the energy standard for buildings. ASHRAE lists guidelines for compliance for building envelope, HVAC systems, service water heating, power, lighting, and other equipment. Included in this report are details on the mechanical system first cost and lost rentable space due to the mechanical system.

A large portion of this assignment is found in the design load estimation and the annual energy consumption and operating costs sections. In order to determine the HAP results needed to assess the design load and energy consumption, a computer model was generated. HAP combines each room square footage, occupancy, equipment loads, and exposure to determine the cooling and heating requirements of the system equipment. The output sizing data from HAP was checked against the actual design specifications for each air handler. HAP is also able to generate operating costs and energy consumption based on utility data which was taken from the Baltimore Gas and Electric website.

Based on the results of this report, certain parts of the building mechanical equipment are not in compliance with ASHRAE Standard 90.1-2004. Also, the DASCO Medical Office Building, based on assumptions made in this report would not achieve LEED certification. Design load estimation, annual energy consumption, and operating cost data are as accurate as HAP is able to produce results based on user input values for utility costs, scheduling profiles, and internal building equipment loads. Each air handler was selected to have extra cooling capacity. This is because the units were selected for the design of the shell and core of the building and no fit-out or occupancy data, which would breakdown each space, was available to the engineers.

Assumptions

Mechanical specifications are written to comply with International Building Code, International Mechanical Code, International Plumbing Code, National Standard Plumbing Code, National Electric Code, Factory Mutual, NFPA regulations, and all state and municipal ordinances, codes and regulations having jurisdiction.

Electrical specifications are written to comply with National Electric Code, NFPA regulations, and all state and municipal ordinances, codes and regulations having jurisdiction.

Any data that was not available from the design documents, specifications, or schedules was either taken from equipment manufacturer product specifications or default data from the HAP database.

LEED-NC Version 2.2

The United States Green Building Council (USGBC) introduced the Leadership in Environmental Design (LEED) Green Building Rating System as a method of certifying and providing design guidelines for the construction of green buildings. LEED for New Construction Version 2.2 was released in 2005 as the most recent adaptation of the achievable credits which can be accumulated throughout the design, construction, and commissioning phases of building design. There are six (6) categories to the LEED rating system, all of which are defined in detail in the LEED for New Construction Version 2.2.

The DASCO Medical Office Building was not designed as a LEED project nor did the design employ measures of green building practice. DASCO Companies owns this building and leases out the tenant space to various medical practices. It was assumed that the most current construction practices and modern materials were used in the design of this building. A LEED checklist was filled out as an assessment of this building's compliance with the LEED-NC rating system, and provides a summary of the assumed achievable credits this building may earn if it was evaluated by the USGBC. It should be noted that because this building was not designed as a green building that most credits were determined as unachievable. This is because most LEED projects require the commitment to plan for sustainable design amongst architects, engineers, contractors, and building owners prior to initial design. The coordination of trades is crucial for a green building to function properly, and earning credits so the building can be designated as a LEED certified project. Since this building was initially constructed and engineered as a shell and core, and since initial construction has undergone two (2) additions to the original plan, it is assumed that proving the current completed state of the building is compliant with LEED criteria would be difficult. Also, it should be noted that the building has been fit-out over the course of seven (7) different phases to reach its completed form. Tracking these types of adjustments to the building as a whole would be complicated, and most LEED projects are designed for the end product, with the knowledge of exactly how the building will be used over time. Also, since the building is not occupied by the owners of the building, it is difficult to assume that sustainability, and future energy saving plans would have been implemented into the design of the shell and core of this building. The various factors specific to this building project and the assumptions that were made using a general knowledge of how complicated the LEED credits can be to achieve, has lead to the checklist provided in Appendix A. The building would not earn enough points to be LEED certified based on this evaluation.

ASHRAE Standard 90.1-2004

Building Envelope

ASHRAE Standard 90.1-2004 provides building compliance criteria for the building envelope, HVAC systems, service water heating, power, lighting, and other equipment. It is necessary to determine some of the criteria for which this building must follow in order to be in compliance with Standard 90.1. The building location determines its climate zone, which is used to break down many of the categories found in this standard. Towson, Maryland is in climate zone 4A, which is a mixed-humid environment. It is suggested that buildings be designed for a cooling dry bulb temperature of 91°F, cooling wet bulb of 74°F, and a winter design condition of 11°F for the Baltimore area.

Building envelope requirements for climate zone 4A are highlighted in Table 1 below. The table shows that the assemblies comply with the maximum U-values and achieve better performance than the required minimum R-values. Assembly values came from HAP as the modeled walls and roof were based on design documents. Each material was input into the program and the U-value feedback from the program is listed in the table below. The glazing, or vertical fenestration, as prescribed in Standard 90.1, should be no more than 50% of the gross wall area. Based on the building elevations, the vertical fenestration is calculated to be 16% of the gross wall area, which is well within the allotted amount. Also, based on the design documents, the type of clear anodized aluminum storefront windows are specified as having 1/8" clear float glass inboard, a 3/8" airspace, and 1/8" low "e" float glass outboard. This data was input into HAP and the program generated an assembly U-value of 0.563 and Solar Heat Gain Coefficient of 0.37. Both of these values comply with Standard 90.1.

Table - 1, Nonresidential Building Envelope Requirements

	Assembly Maximum	Insulation Minimum	Actual Assembly	Actual Insulation
Roofs	U-0.063	R-15	U-0.061	R-15
Walls, Above Grade	U-0.124	R-13	U-0.042	R-19
Walls, Below Grade	C-1.140	None Required	C-0.104	R-7 board insulation
	Assembly Maximum	**Solar Heat Gain Coefficient**	**Actual Assembly**	**Actual SHGC**
Vertical Glazing, % of Wall	fixed U-0.57	SHGC-0.39 all	U-0.563	SHGC-0.37
(10.1-20.0%)		SGHC-0.49 north		SHGC-0.37

Heating, Ventilating, and Air Conditioning

The HVAC system for this building is a variable air volume with parallel fan-powered boxes with supply air conditioned through packaged roof top units. The packaged roof top units are direct expansion cooling type. Heating is accomplished through electric resistance in each fan-powered VAV box. According to Standard 90.1 Table 6.5.1, no economizer is required for climate zone 4A; however the building specifications indicate that each AHU has a 0-100% economizer to allow for “free” cooling when outdoor air conditions are suitable.

The fan power limitations prescribed by Standard 90.1 are based on the supply fan airflow rate at design conditions. Design conditions used in this compliance check were generated from the system model from HAP. Table 2 below shows the evaluation of the fan power compliance with what is written in Standard 90.1. As the table shows, the calculated motor power for AHU-1 and AHU-2 is much greater than the limitation set by AHSRAE. AHU-3 is close to the limitation, however still exceeds the performance requirement. The excessive motor horsepower may be due to the fact that both AHU-1 and AHU-2 were designed as part of the shell and core phase of this building. Therefore both AHUs were selected for an estimated load, and may have complied with Standard 90.1 prior to each fit-out phase of the building construction. Now that the building is complete and final occupancy is reflected in the HAP model, the AHUs are oversized for the ventilation and cooling load they must provide to the spaces. AHU-3 was added to the project during one fit-out phase in which the engineers analyzed the current air handling capabilities, and felt that AHU-1 and AHU-2 did not have enough capacity. Therefore a third AHU was added to the project. This unit was designed for the spaces which it supplies, and is much closer to the limitation value set by ASHRAE.

Table - 2, Fan Power Limitation Variable Volume System				
	Design supply (cfm)	Fan Horsepower	Allowable Nameplate Motor Power (ASHRAE 90.1-2004)	Calculated Motor Power
AHU-1	25070	2 @ 40 hp	1.5 hp/1000 cfm	3.2 hp/1000 cfm
AHU-2	15915	2 @ 40 hp	1.5 hp/1000 cfm	5.1 hp/1000 cfm
AHU-3	5278	1 @ 10 hp	1.7 hp/1000 cfm	1.9 hp/1000 cfm

Pipe and duct minimum insulation values are also listed in the HVAC section. Table 6.8.3 of ASHRAE Standard 90.1-2004 lists the minimum thickness of pipe insulation based on fluid design temperature and nominal pipe size. For the domestic water system, hot water is designated as 140°F leaving water temperature. Based on reading the table, the insulation conductivity range can fall between 0.22 to 0.28 for fluid design temperatures between 105°F and 140°F. The mechanical specifications list pipe insulation conductivity valves are to fall between 0.23 and 0.27. As specified, the pipe insulation complies with Standard 90.1. Duct insulation values are listed in Table 6.8.2A in AHSRAE Standard 90.1-2004. The only ducted air distribution is through cooling only ducts. All return air travels through a ceiling plenum. For climate zone 4 the minimum duct insulation R-value for ducts located in unconditioned space is

R-1.9. The mechanical specifications call for 2” rigid insulation on supply ducts. This is equivalent to an R-value of 8, which well exceeds the requirement.

Service Water Heating

The basis of design for the domestic water heaters is the A.O. Smith Dura-Power Model DEL-40. As indicated on the manufacturer specification sheet for this product, each electric water heater meets or exceeds the requirements of ASHRAE Standard 90.1-1999 for energy efficiencies. According to ASHRAE Standard 90.1-2004, electric water heaters using less than 12kW input and are rated for greater than 20 gallons, have a required performance of 0.93-0.00132V EF. Because no data could be located referencing the 1999 Standard, it is assumed that the water heaters also comply with the 2004 Standard.

Power

The power requirements described in ASHRAE Standard 90.1-2004 state that the maximum voltage drop for feeders must be no more than 2%. Also the maximum voltage drop for branch circuits must not exceed 3%.

Lighting

ASHRAE Standard 90.1-2004 details two methods for determining lighting power densities. The more general building area method gives specific values for building area types listed as hospital, office, retail, etc. The space-by-space method is more detailed in that the table gives lighting power densities for each room type based on room usage. The lighting power density requirement for a health care-clinic building is 1.0 Watts per square foot. Table 3 provides a summary of evaluated square footage for the building spaces and the designed lighting based on building construction drawings. Each room was reviewed to find the total number of fixtures and the total wattage was summed for all spaces based on the lighting fixture schedules.

Table - 3, Lighting Power Density, Building Area Method			
ASHRAE Standard 90.1-2004, Health care-clinic (1.0 W/ft^2)			
	ft^2	Watts	Watts/ft^2
DASCO MOB	57,703	104,275	1.81

Table 3 above shows that based on the building area method, the DASCO Medical Office Building exceeds the lighting power density prescribed in Standard 90.1. Another way to evaluate the lighting power density is to use the space-by-space method. Table 4 shows a breakdown of how the spaces lighting was entered into the HAP model. This information was also used to evaluate the buildings compliance using the space-by-space method.

Table - 4, Lighting Power Densities, Space-by-Space	
Common Space Type	LPD (W/ft^2)
Office	1.1
Conference	1.3
Lobby	1.3
Laboratory	1.4
Restrooms	0.9
Corridor	0.5
Nurse Station	1.0
Exam/Treatment	1.5
Medical Supply	1.4
Radiology	0.4
Equipment	1.2
Control	0.5
Electrical/Mechanical	1.5
Stairs	0.6
Library, Reading	1.2
Active Storage	0.8
Lounge	1.2

A detailed space-by-space breakdown, which lists each room and its compliance with the Table-4 above, is provided in Appendix B. The DASCO Medical Office Building has very few rooms that actually comply with this standard. Most rooms are over the Watts per square foot requirements.

Mechanical System First Cost

The DASCO Medical Office Building mechanical system first cost data is based on the payment sheet for each phase of work completed by Southern Mechanical Inc., mechanical contractors. Equipment cost of piping, plumbing fixtures, water heaters, air handlers, sheet metal, ATC controls, and insulation are included along with balancing coordinated drawings and any contract revisions based on the progress of construction as seen fit by the mechanical contractors. First cost data for the building totaled $678,784.79. This is equivalent to $9.73 per square foot for mechanical equipment in the building.

Lost rentable space due to mechanical system equipment and vertical shafts provided for routing pipes and ductwork amounts to 930 square feet. The areas containing mechanical equipment are janitor's closets on each floor that house domestic water heaters. The other areas contributing to the lost rentable space are a 74 square foot and 65 square foot vertical mechanical shaft through each floor. All three AHUs are located on roof areas; also specialized chillers which provided cooling directly to each linear accelerator, and the PET/CT scanner located on the ground floor, are located outside of the linear accelerator bunker on the south side of the building. Only 1.3% of the building square footage is lost to mechanical needs.

Yearly Energy Utilization Data

The DASCO Medical Office Building was designed as an electricity consuming building. Three (3) direct expansion rooftop air handling units send conditioned air to parallel fan powered VAV boxes with electric reheat supplying each room. Return air is sent through a ceiling plenum that blows through three (3) return fans, one for each AHU. All of the systems, including the lighting and other normal equipment that can be found in an office type building, with the addition of certain specialized medical equipment, consume energy in the form of generated electricity. Baltimore Gas and Electric Company provide energy to the Saint Joseph Medical Center which is located in Towson, Maryland.

Yearly utilization data, meter data, or utility bills were unable to be obtained for this building. Therefore in order to calculate energy consumption, the utility rates from Baltimore Gas and Electric Company (BGE) were taken from the company website and summarized in Table 5 below.

Table - 5, Baltimore Gas and Electric Company, Electric Rates		
General Service Small - Electric (cents per kWh)		
	Summer	Non-Summer
Peak	15.173	11.817
Intermediate-Peak	9.177	10.109
Off-Peak	7.254	7.984

Carrier's Hourly Analysis Program (HAP) was used to generate a yearly energy simulation for this building. The rating period used in the computer model is as follows: Peak hours between 10am and 8pm on weekdays, Intermediate hours are 7am to 10am and 8pm to 11pm on weekdays, and Off-Peak hours are weekends and national holidays which are listed on the BGE rate plan. Summer hours are charged between the months of June through September, winter billing months are October through May.

Load and Energy Estimation

Design Load

Estimating the design load required the use of Carrier's Hourly Analysis Program (HAP). Each of the 277 rooms was individually entered into the program. Data used for the model consisted of the outdoor air ventilation rates based on the design documents, lighting and equipment loads found on the drawings, and also the design occupancies based on the furniture plans. HAP also takes into consideration the floor to floor height, and whatever exposures rooms may have to the outside including window area. In order to simulate an accurate design day, occupancy schedules are made in the program, and can be found in Figures 1-4 below. These schedules were estimated based on a normal office building that operates from 8am to 5pm on weekdays, and from 10am to 4pm on the weekends. Any holidays throughout the year in which the building may not be open were entered into the computer and based on holidays that Baltimore Gas and Electric acknowledges as charged off-peak hours.

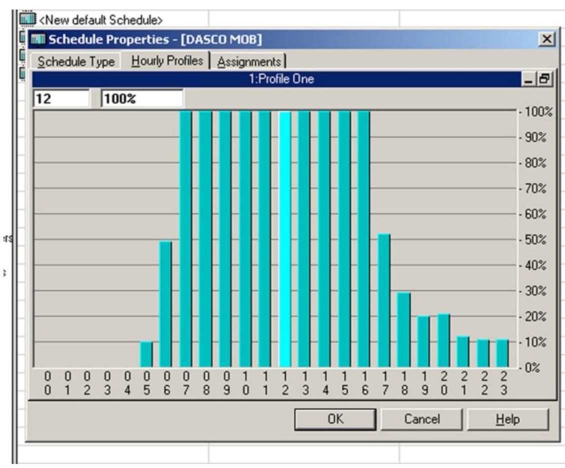

Figure 1 - Weekday Schedule

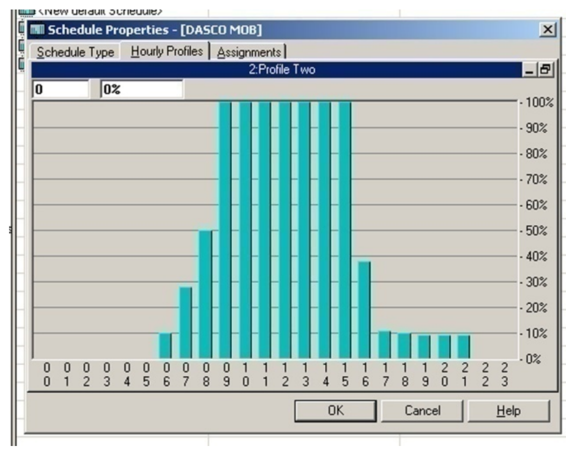

Figure 2 - Weekend Schedule

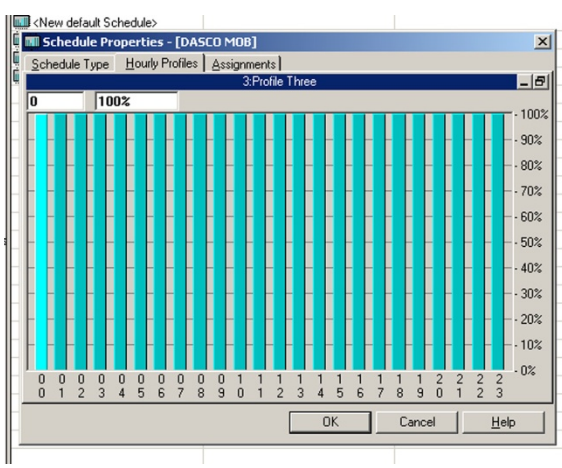

Figure 3 - Design Schedule

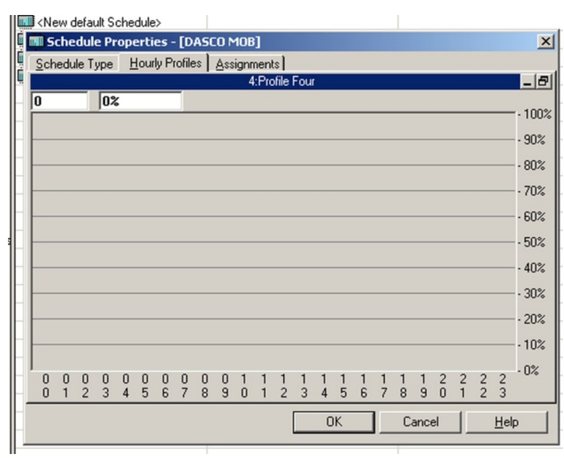

Figure 4 - Holiday Schedule

Load sources entered into HAP such as design occupancy, equipment loads, lighting loads, and the outdoor air ventilation rate can be found in the tables in Appendix B. The outdoor air ventilation rate is 20% of the supply air.

The comparison of design conditions and computed loads using HAP are listed in Tables 6-8 below. The ventilation data is exactly the same because the building model was sized using outdoor air ventilation rates from the design documents. However, the cooling square feet per ton and supply cubic feet per minute per square foot data is different for all three (3) air handlers. This is because each air handler has a maximum cooling capacity in tons as listed in the design schedules. However, when the computer models each space, only the design day loads are most important. Because of building orientation, occupancy schedules, time of day, and weather data, the building's mechanical equipment capacity is hardly ever used to its full potential. This is evident in the computed load row of Tables 6-8 below. Each air handler has more capacity than HAP modeled as necessary to cool the building on the design day. Again, it should be noted that the engineers selected AHU-1 and AHU-2 prior to the building having floor plans suiting each tenant. Some type of approximation as to how the space would be used, and how many people would occupy each space was added to the shell and core loads of the building for initial design.

Table - 6, Design and Computed Loads AHU-1

	cooling ft^2/ton	supply cfm/ft^2	ventilation supply cfm/ft^2
Design	190.2	1.69	0.34
Computed	300.9	1.03	0.33

Table - 7, Design and Computed Loads AHU-2

	cooling ft^2/ton	supply cfm/ft^2	ventilation supply cfm/ft^2
Design	218.9	1.36	0.27
Computed	383.3	0.59	0.28

Table - 8, Design and Computed Loads AHU-3

	cooling ft^2/ton	supply cfm/ft^2	ventilation supply cfm/ft^2
Design	228.7	1.49	0.30
Computed	369.8	0.74	0.30

Annual Energy Consumption and Operating Costs

The information provided in Tables 9-14 below was generated using HAP building simulation. Performance data was taken from the design documents, and some was part of default equipment selection from the HAP database. The loads are for the three (3) packaged roof top air handling units which all operate using electricity. There is no central chiller plant utilized in this project, nor are there any types of boilers or steam generators. Heating is accomplished by electric resistance in each parallel fan powered VAV box.

There was no energy model completed by the engineers for this building. Perhaps this is because the building was constructed and fit-out in phases, which would make developing a complete and accurate model difficult.

Table - 9, AHU Fan Performance Data

	Supply Fan		Return Fan	
	Static Pressure	Efficiency	Static Pressure	Efficiency
AHU-1	7.75	54%	1.25	54%
AHU-2	7.75	54%	1.25	54%
AHU-3	2.82	54%	0.5	54%

Table - 10, Annual Energy Consumption

	kWh	Annual Cost per Square Foot
HVAC - Components		
Electric	657,547	1.11
Non-HVAC Components		
Electric	253,181	0.433
Building Total	910,728	1.543

Table - 11, Annual Costs

Component	Cost
Air System Fans	34,357
Cooling	1,139
Heating	28,524
Pumps	0
Cooling Tower Fans	0
HVAC Sub-Total	64,019
Lights	24,980
Electric Equipment	0
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	24,980
Grand Total	89,000

Table - 12, Energy Consumption by System Component				
Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	1,186,868	20.576	4,238,812	73.485
Cooling	38,102	0.661	136,080	2.359
Heating	1,018,467	17.656	3,637,383	63.058
Pumps	0	0	0	0
Cooling Towers	0	0	0	0
HVAC Sub-Total	2,243,437	38.893	8,012,275	138.902
Lights	863,853	14.976	3,085,189	53.485
Electric Equipment	0	0	0	0
Misc. Electric	0	0	0	0
Misc. Fuel Use	0	0	0	0
Non-HVAC Sub-Total	863,853	14.976	3,085,189	53.485
Grand Total	3,107,290	53.868	11,097,463	192.387

Table - 13, Annual Cost per Square Foot	
Component	Cost per Square Foot
Air System Fans	0.596
Cooling	0.02
Heating	0.495
Pumps	0
Cooling Tower Fans	0
HVAC Sub-Total	1.11
Lights	0.433
Electric Equipment	0
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	0.433
Grand Total	1.543

Table - 14, Emissions Data		
	Generation Rate	Annual Emissions
CO_2	1.38 lb/kWh	1256771 lb
SO_2	3.42 g/kWh	3115 g
NOx	2.01 g/kWh	1831 g

Appendix A

LEED for New Construction v2.2
Registered Project Checklist

Project Name: DASCO Medical Office Building
Project Address: 7601 Osler Drive, Towson, MD

Yes	?	No			
2	4	8		**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

Yes	?	No				
1	2	14			**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.

Yes	?	No				
1	1	8	Credit 1		**Optimize Energy Performance**	1 to 10
				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			
	5	8		**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 Regic	1
	1		Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regic	1
	1		Credit 6	**Rapidly Renewable Materials**	1
	1		Credit 7	**Certified Wood**	1

Yes	?	No			
2	2	11		**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			
	1	4		**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		
5	16	48	**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

AHU-1

Room	Function	design cfm supply	area (Az)	Design Occupancy (Pz)	Equipment Load (BTUh)	Lighting Load (ASHRAE 90.1-2004)	Lighting Design (W)	Watts/ft^2	Complies
003	corridor	315	1480	0	-	0.5	1589	1.07	no
003a	link	495	304	0	-	0.5	312	1.03	no
008	electrical room	50	84	0	-	1.5	64	0.76	yes
009	telephone	380	55	0	-	1.5	64	1.16	yes
014	elec. Room	1000	185	0	-	1.5	64	0.35	yes
126	director	395	140	1	500	1.1	153	1.09	yes
125	chief tech	195	85	1	500	1.1	102	1.20	no
124	physicist	305	85	1	500	1.1	102	1.20	no
123	treatment planning	570	120	1	500	1.1	192	1.60	no
122	dressing	65	29	1	-	1.1	51	1.76	no
121	dressing	50	29	1	-	1.1	51	1.76	no
127	corridor	160	265	0	-	0.5	576	2.17	no
143	corridor	75	179	0	-	0.5	288	1.61	no
128	office	245	123	1	500	1.1	102	0.83	yes
129	hc toilet	50	53	0	-	0.9	51	0.96	no
131	chart storage	85	213	0	-	0.8	384	1.80	no
132	file serv/phone/stor	145	70	0	-	0.8	128	1.83	no
136	exam	120	108	2	-	1.5	192	1.78	no
135	exam	105	90	2	-	1.5	192	2.13	no
134	exam	105	90	2	-	1.5	192	2.13	no
144	storage	50	89	0	-	0.8	102	1.15	no
146	mold block	145	100	0	-	1.5	192	1.92	no
145	corridor	100	100	0	-	0.5	192	1.92	no
147	staff lounge	185	122	3	3420	1.2	192	1.57	no
148	chart storage	170	159	0	-	0.8	256	1.61	no
150	rad/oncogolgy stor	60	188	0	-	0.8	288	1.53	no
149	chart storage	50	127	0	-	0.8	192	1.51	no
#	shell space	2000	2075	10	-	1.1	512	0.25	yes
112	linacc	1365	789	2	10000	1.5	1888	2.39	no
111	linacc	1485	789	2	10000	1.5	1688	2.14	no
108	mech room	165	76	0	-	1.5	64	0.84	yes
110	control	785	209	2	1000	0.5	294	1.41	no
113	control	785	219	2	1000	0.5	243	1.11	no
107	control room	460	126	2	1000	0.5	392	3.11	no
106	ct simulator	1050	287	2	15800	1.5	772	2.69	no
105	hc toilet	50	39	0	-	0.9	51	1.31	no
104	ofc mgr	185	120	2	500	1.1	192	1.60	no
115	view boxes	100	168	0	-	0.5	147	0.88	no
139	hc toilet	50	48	0	-	0.9	130	2.71	no
117	dirty	0	18	0	-	0.8	51	2.83	no
118	clean	50	18	0	-	0.8	51	2.83	no
114	dark room	130	54	1	-	1.2	230	4.26	no
119	dressing	50	44	1	-	1.1	51	1.16	no
120	sub-waiting	135	154	5	-	1.1	192	1.25	no
137	nursing	175	79	1	500	1.0	192	2.43	no
138	stretcher	50	81	1	-	0.8	96	1.19	no
116	corridor	0	133	0	-	0.5	192	1.44	no
103	storage	50	67	0	-	0.8	128	1.91	no
102	reception	305	135	4	1000	1.1	192	1.42	no
140	conference	800	182	9	585	1.3	288	1.58	no
141	exam	105	90	2	-	1.5	192	2.13	no
142	med storage	50	58	0	-	0.8	128	2.21	no
101	waiting	1350	415	12	-	1.3	340	0.82	yes
100-04	prep/injection	105	92	1	-	1.5	208	2.26	no
100-06	prep/injection	105	92	1	-	1.5	208	2.26	no
100-08	prep/injection	105	92	1	-	1.5	208	2.26	no
100-10	patient toilet	50	52	0	-	0.9	102	1.96	no
100-12	hot lab	105	90	1	600	1.4	136	1.51	no

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Room	Function	design cfm supply	area (Az)	Design Occupancy (Pz)	Equipment Load (BTUh)	Lighting Load (ASHRAE 90.1-2004)	Lighting Design (W)	Watts/ft^2	Complies
100-01	corridor	105	322	0	-	0.5	468	1.45	no
100-00	waiting	170	184	6	-	1.3	260	1.41	no
100-03	reg/techs	250	163	2	2100	1.1	204	1.25	no
100-05	staff toilet	50	52	0	-	0.9	102	1.96	no
100-07	control	500	124	1	4011	1.5	292	2.35	no
100-09	pet/ct scan	1015	374	2	15000	1.5	720	1.93	no
r-005	social work/diet	165	126	1	500	1.1	192	1.52	no
r-007	nurses	165	120	1	1000	1.0	192	1.60	no
r-008	phd	115	108	1	500	1.1	192	1.78	no
r-004	registry/research	1105	800	16	10000	1.2	1440	1.80	no
r-003	research nurses	325	118	1	1000	1.0	192	1.63	no
r-002	office	150	91	1	500	1.1	192	2.11	no
r-006	genetics pastoral	165	137	1	1000	1.1	288	2.10	no
r-001	recep/waiting	825	433	13	-	1.3	864	2.00	no
c-11	corridor	55	107	0	-	0.5	192	1.79	no
e101	elevator lobby	570	738	7	-	1.3	1294	1.75	no
i-117	phlebotomy	140	140	1	500	1.4	204	1.46	no
i-118	pharmacy	160	92	2	1240	1.4	384	4.17	no
i-118a	work room	265	112	1	500	1.1	384	3.43	no
i-118b	ante room	565	71	1	-	1.1	192	2.70	no
i-118c	clean room	750	112	0	-	1.1	272	2.43	no
i-119	reception	190	202	6	-	1.1	312	1.54	no
i-120	waiting	834	742	25	-	1.3	1349	1.82	no
i-121a	front office	295	223	3	1500	1.1	359	1.61	no
i-123	soiled utility	50	86	0	-	0.8	192	2.23	no
i-124	toilet	0	53	0	-	0.9	77	1.45	no
i-125	toilet	0	53	0	-	0.9	77	1.45	no
i-126	hall	200	334	0	-	0.5	460	1.38	no
i-128	consult	130	91	5	500	1.1	153	1.68	no
i-130	triage	130	72	1	-	1.5	192	2.67	no
i-131	clean utility	185	245	0	-	0.8	480	1.96	no
i-132a	infusion bay 2	10985	4205	16	2000	1.5	10446	2.48	no
i-134	private office	375	152	0	500	1.1	287	1.89	no
i-134a	toilet	50	50	0	-	0.9	83	1.66	no
i-136	break room	225	139	4	1340	1.2	320	2.30	no
i-138	it closet	0	8	0	-	0.8	0	0.00	yes
c-10	corridor	300	550	0	-	0.5	561	1.02	no
103	telephone	380	55	0	-	1.5	51	0.93	yes
104	electrical room	50	84	0	-	1.5	51	0.61	yes
105	jan clos.	0	37	0	-	1.5	51	1.38	yes
106	mens toilet	0	57	0	-	0.9	51	0.89	yes
107	womens toilet	0	57	0	-	0.9	51	0.89	yes

AHU-2

Room	Function	design cfm supply	area (Az)	Design Occupancy (Pz)	Equipment Load (BTUh)	Lighting Load (ASHRAE 90.1-2004)	Lighting Design (W)	Watts/ft^2	Complies
s-202	telephone	380	55	0	-	1.5	64	1.16	yes
s-203	elec. Room	50	84	0	-	1.5	64	0.76	yes
s-204	jan. clos.	0	37	0	-	1.5	64	1.73	no
s-205	mens toilet	0	57	0	-	0.9	51	0.89	yes
s-206	womens toilet	0	57	0	-	0.9	51	0.89	yes
200	waiting	1110	520	20	-	1.3	864	1.66	no
201	reception	410	470	4	3300	1.1	768	1.63	no
202	corridor	345	1141	0	-	0.5	2496	2.19	no
204	exam	95	108	1	-	1.5	192	1.78	no
205	exam	95	108	1	-	1.5	192	1.78	no
206	phone room	180	44	0	-	1.5	96	2.18	no
207	break room	295	239	12	3420	1.2	576	2.41	no
208	meds closet	50	64	0	-	0.8	96	1.50	no
209	supply closet	0	35	0	-	0.8	96	2.74	no
210	toilet/shower	50	80	0	-	0.9	468	5.85	no
211	surgeon's office	340	254	3	500	1.1	288	1.13	no
212	surgeon's office	340	159	3	500	1.1	288	1.81	no
213	surgeon's office	395	157	3	500	1.1	288	1.83	no
214	pa office	110	129	3	500	1.1	192	1.49	no
215	physicans office	210	120	3	500	1.1	192	1.60	no
216	physicans office	395	120	3	500	1.1	192	1.60	no
217	exam	95	100	1	-	1.5	192	1.92	no
218	physicans office	210	114	3	500	1.1	192	1.68	no
219	physicans office	210	112	3	500	1.1	192	1.71	no
220	managers office	290	91	3	500	1.1	192	2.11	no
221	private office 1	195	92	3	500	1.1	192	2.09	no
222	private office 2	195	88	3	500	1.1	192	2.18	no
223	private office 3	295	96	3	500	1.1	192	2.00	no
224	private office 4	195	97	3	500	1.1	192	1.98	no
225	private office 5	195	91	3	500	1.1	192	2.11	no
226	private office 6	295	96	3	500	1.1	192	2.00	no
227	private office 7	195	101	3	500	1.1	192	1.90	no
228	private office 8	195	92	3	500	1.1	192	2.09	no
229	private office 9	295	95	3	500	1.1	192	2.02	no
230	private office 10	300	158	5	500	1.1	384	2.43	no
231	research office	205	166	2	1250	1.1	384	2.31	no
232	research supply	85	253	0	-	0.8	384	1.52	no
233	open area	625	728	8	5100	1.1	960	1.32	no
234	hc toilet	50	48	0	-	0.9	396	8.25	no
235	research supply	85	273	0	-	0.8	480	1.76	no
a-202	front office	140	154	1	750	1.1	300	1.95	no
a-203	reading	175	275	1	500	1.1	310	1.13	no
a-205	us 1	300	153	1	-	1.1	432	2.82	no
a-206	hallway	120	321	0	-	0.5	459	1.43	no
a-207	mammo 1	395	146	1	-	1.5	432	2.96	no
a-208	mammo 2	480	143	1	-	1.5	432	3.02	no
a-209	us 2/mammo 3	420	147	1	-	1.5	412	2.80	no
a-210	storage	50	59	0	-	0.8	96	1.63	no
a-211	patient toilet	0	46	0	-	0.9	154	3.35	no
a-212	dressing	180	199	5	-	1.1	515	2.59	no
a-213	tech work area	270	90	1	2000	1.1	747	8.30	no
a-215	staff toilet	0	51	0	-	0.9	154	3.02	no
a-216	dexa	205	94	2	-	1.1	192	2.04	no
a-217	manager	105	96	2	1000	1.1	192	2.00	no
a-218	imaging registration	175	60	2	1000	1.1	102	1.70	no
a-219	shared waiting	1330	1152	44	-	1.3	2236	1.94	no
a-220	check in	155	136	2	1000	1.1	510	3.75	no
a-221	manager office	90	82	1	500	1.1	192	2.34	no

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Room	Function	design cfm supply	area (Az)	Design Occupancy (Pz)	Equipment Load (BTUh)	Lighting Load (ASHRAE 90.1-2004)	Lighting Design (W)	Watts/ft^2	Complies
a-222	check out	130	76	2	1000	1.1	406	5.34	no
a-224	conference room	260	184	6	-	1.3	308	1.67	no
a-225	exam 6	285	120	1	-	1.5	296	2.47	no
a-226	exam 1	285	133	1	-	1.5	296	2.23	no
a-227	sterilization	410	120	2	500	1.0	51	0.43	yes
a-228	exam 5	285	121	1	-	1.5	296	2.45	no
a-230	exam 3	320	135	1	-	1.5	244	1.81	no
a-231	exam 4	285	120	1	-	1.5	296	2.47	no
a-232	office	370	193	7	750	1.1	462	2.39	no
a-233	office	290	125	3	1000	1.1	192	1.54	no
a-234	hallway	335	638	0	-	0.5	918	1.44	no
a-235	bbc	675	274	3	-	1.1	740	2.70	no
a-236	patient toilet	0	52	0	-	0.9	154	2.96	no
a-238	exam 2	285	135	1	-	1.5	520	3.85	no
a-239	staff toilet	0	52	0	-	0.9	154	2.96	no
a-242	storage	50	68	0	-	0.8	96	1.41	no
a-244	kitchen	215	40	0	3420	1.2	96	2.40	no
a-245	med rec	305	274	6	1250	1.1	576	2.10	no
a-246	public toilet	0	52	0	-	0.9	51	0.98	no
s-302	telephone	380	54	0	-	1.5	64	1.19	yes
300	waiting	2400	1075	44	-	1.3	1788	1.66	no
301	reception	285	247	2	2100	1.1	480	1.94	no
302	charts	2050	1630	14	6450	1.1	2400	1.47	no
304	office manager	285	127	1	500	1.1	384	3.02	no
305	corridor	1605	2696	0	-	0.5	4224	1.57	no
310	staff toilet	50	51	0	-	0.9	130	2.55	no
311	janitor	0	47	0	-	1.5	96	2.04	no
313	file room	830	835	2	1050	1	1632	1.95	no
314	patient toilet	50	47	0	-	0.9	130	2.77	no
315	patient toilet	50	47	0	-	0.9	130	2.77	no
316	break room	685	431	18	3420	1.2	768	1.78	no
318	server	195	50	0	-	0.8	96	1.92	no
319	file area	300	270	2	-	1	540	2.00	no
320	nuclear lab	600	1145	8	12500	1.5	1972	1.72	no
321	hot lab	210	73	2	-	1.4	96	1.32	yes
322	blood lab	115	80	2	-	1.4	96	1.20	yes
323	echo	390	168	2	-	1.4	288	1.71	no
324	research office	350	110	2	1000	1.1	192	1.75	no
325	stress test	650	270	4	-	1.5	576	2.13	no
326	echo	445	198	3	-	1.4	340	1.72	no
327	pa office	405	161	1	5000	1.1	192	1.19	no
328	physicans office	240	123	1	5000	1.1	192	1.56	no
329	physicans office	330	130	1	5000	1.1	192	1.48	no
330	physicans office	240	133	1	5000	1.1	192	1.44	no
331	physicans office	330	132	1	5000	1.1	192	1.45	no
332	physicans office	330	132	1	5000	1.1	192	1.45	no
333	physicans office	240	132	1	5000	1.1	192	1.45	no
334	physicans office	425	132	1	5000	1.1	192	1.45	no
335	physicans office	150	132	1	5000	1.1	192	1.45	no
336	physicans office	425	132	1	5000	1.1	192	1.45	no
337	physicans office	440	132	1	5000	1.1	192	1.45	no
339	exam 1	150	93	2	-	1.5	192	2.06	no
340	exam 3	90	91	2	-	1.5	192	2.11	no
341	exam 2	90	80	2	-	1.5	192	2.40	no
344	exam 4	90	90	2	-	1.5	192	2.13	no
345	patient toilet	50	42	0	-	0.9	130	3.10	no
346	patient toilet	50	43	0	-	0.9	130	3.02	no
347	exam 5	90	102	2	-	1.5	192	1.88	no

AHU-2

Room	Function	design cfm supply	area (Az)	Design Occupancy (Pz)	Equipment Load (BTUh)	Lighting Load (ASHRAE 90.1-2004)	Lighting Design (W)	Watts/ft^2	Complies
348	exam 6	90	92	2	-	1.5	192	2.09	no
349	exam 7	90	92	2	-	1.5	192	2.09	no
350	sink area	50	88	1	-	1.0	192	2.18	no
351	exam 8	90	92	2	-	1.5	192	2.09	no
352	exam 9	90	101	2	-	1.5	192	1.90	no
353	techs	115	73	3	1500	1.1	192	2.63	no
354	techs	115	72	2	500	1.1	192	2.67	no
356	ekg area	120	84	1	-	1.1	96	1.14	no
357	exam 10	90	102	2	-	1.5	192	1.88	no
358	exam 11	90	93	2	-	1.5	192	2.06	no
359	exam 12	90	92	2	-	1.5	192	2.09	no
360	exam 15	90	92	2	-	1.5	192	2.09	no
361	exam 14	90	93	2	-	1.5	192	2.06	no
362	exam 13	90	102	2	-	1.5	192	1.88	no
366	exam 16	90	98	2	-	1.5	192	1.96	no
367	exam 17	90	92	2	-	1.5	192	2.09	no
368	exam 18	90	92	2	-	1.5	192	2.09	no
369	exam 19	90	102	2	-	1.5	192	1.88	no
370	sub-waiting	350	156	10	-	1.3	288	1.85	no
371	exam 21	90	88	2	-	1.5	192	2.18	no
372	exam 20	90	87	2	-	1.5	192	2.21	no
374	research files	60	97	0	-	1.0	192	1.98	no
375	supply closet	50	42	0	-	0.8	96	2.29	no

AHU-3

Room	Function	design cfm supply	area (Az)	Design Occupancy (Pz)	Equipment Load (BTUh)	Lighting Load (ASHRAE 90.1-2004)	Lighting Design (W)	Watts/ft^2	Complies
129	office	550	230	5	750	1.1	384	1.67	no
128a	toilet	0	52	0	-	0.9	102	1.96	no
127	exam room	160	115	3	-	1.5	192	1.67	no
126	exam room	265	113	3	-	1.5	192	1.70	no
125	treatment room	470	141	3	-	1.5	192	1.36	yes
124	exam room	160	122	3	-	1.5	192	1.57	no
122	exam room	160	122	3	-	1.5	192	1.57	no
121	treatment room	470	141	3	-	1.5	192	1.36	yes
128	exec reception	665	338	7	1000	1.5	768	2.27	no
131	conference/library	955	518	42	-	1.5	584	1.13	yes
120	exam room	265	112	3	-	1.5	192	1.71	no
119	exam room	160	115	3	-	1.5	192	1.67	no
115	exam room	160	115	3	-	1.5	192	1.67	no
114	exam room	265	112	3	-	1.5	192	1.71	no
113	exam room	470	141	3	-	1.5	192	1.36	yes
112	exam room	160	122	3	-	1.5	192	1.57	no
106	exam room	160	122	3	-	1.5	192	1.57	no
105	exam room	265	112	3	-	1.5	192	1.71	no
104	exam room	470	141	3	-	1.5	192	1.36	yes
103	exam room	160	122	3	-	1.5	192	1.57	no
102	waiting room	1595	808	40	-	1.3	1196	1.48	no
101	patient toilet	0	76	0	-	0.9	102	1.34	no
116	soiled utility	0	33	0	-	0.8	96	2.91	no
111	staff toilet	0	50	0	-	0.9	102	2.04	no
110	patient toilet	0	50	0	-	0.8	102	2.04	no
108	clean utility	100	56	0	-	1.1	96	1.71	no
107	front office	365	320	6	3400	1.3	772	2.41	no
100	entry vestibule	150	245	2	-	1.1	640	2.61	no
130	office	270	170	5	750	1.1	384	2.26	no
132	office	360	124	3	750	1.1	256	2.06	no
133	office	270	132	3	750	1.1	256	1.94	no
134	office	240	118	3	750	1.1	256	2.17	no
140	md mgr office	95	85	1	750	1.1	256	3.01	no
139	office	130	115	3	750	1.1	256	2.23	no
138	office	130	112	3	750	1.1	256	2.29	no
137	inf mgr office	95	85	1	750	1.1	256	3.01	no
c-7	corridor	105	488	0	-	0.5	884	1.81	no
c-1	corridor	290	918	0	-	0.5	2100	2.29	no

References

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