Andrew Rhodes

The Pennsylvania State University
Architectural Engineering – Mechanical

The Hilton Baltimore Convention Center Hotel

Mechanical Technical Report #2

Building and Plant Energy Analysis Report

Faculty Advisor: Dr. William Bahnfleth

October 27, 2006

Thesis Building Sponsor:
Southland Industries
22960 Shaw Road, Suite 800
Sterling, VA 20166
www.southlandind.com

Table of Contents

1.0 Executive Summary

The purpose of this report is to analyze the Hilton Baltimore Convention Center Hotel (HBCCH) for its building and plant energy performance. This analysis includes a LEED-NC Version 2.2 evaluation, ASHRAE Standard 90.1-2004 compliance study, and building load, energy, and cost calculations. Lost rentable space due to the building mechanical system and building mechanical system first cost were also calculated.

The HBCCH is not designed to be a LEED rated building, but the LEED-NC Version 2.2 evaluation could still be carried out. Overall, the HBCCH would score approximately 25 LEED points, meaning it would not achieve certification. Changes to the original design would be necessary in order to obtain more points.

ASHRAE Standard 90.1-2004 requirements are met for building envelope criteria, but the HBCCH's lighting system and some aspects of the HVAC system do not comply with the standard. Overall, 3.08% of the rentable space in the HBCCH is lost due to the building's mechanical system. At approximately $16.8 million, the mechanical system first cost is almost $26 per square foot. This cost is fairly low because the HBCCH has no onsite chiller or boiler plant. Both chilled water and steam are purchased from two separate district systems.

Building load calculations, energy usage, and cost breakdown were found using Trane TRACE700. The results from the TRACE analysis were then compared to the actual design conditions listed in the construction documents. The vast majority of the air flow rates and cooling capacities were similar to those in the design documents. At a cost of $7 per square foot, the cooling cost for the HBCCH is rather high. This is most likely due to the fact that all chilled water is purchased from a district system. The high utility cost is offset by lower electricity costs and lower building mechanical system first costs.

2.0 LEED-NC Version 2.2

Every building, no matter how well designed, has some negative impacts on its surrounding environment. In a world where energy prices are soaring and environmental concerns are constantly increasing, it is imperative that design engineers attempt to make their work more environmentally friendly.

For the purpose of this report, the systems of the HBCCH were assessed using the Leadership in Energy and Environmental Design Green Building Rating System for New Construction and Major Renovations (LEED-NC Version 2.2). The rating/point system for LEED-NC Version 2.2 is broken down into six categories with a total of sixty-nine possible points. Categories include Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, and LEED Innovation. The level of certification is awarded based on the total number of points obtained. The U.S. Green Building Council recognizes the four levels of certification seen below in Table-1.

Table-1: LEED-NC Version 2.2 Certification Levels

Certification	Minimum Points	Maximum Points
None	0	25
Certified	26	32
Silver	33	38
Gold	39	51
Platinum	52	69

The design team for the HBCCH does not intend for the building to become LEED Certified, however the assessment of the building's systems can still be carried out. Upon completion, it was found that the HBCCH's current design would obtain twenty-five points. A breakdown of how the building scored in each of the six categories can be seen below in Table-2. Please refer to Appendix A for the completed LEED-NC Version 2.2 Registered Project Checklist.

Table-2: LEED Points Obtained Using Original Building Design

Category	Possible Points	Points the Design Currently Meets
Sustainable Sites	14	7
Water Efficiency	5	1
Energy and Atmosphere	17	4
Materials and Resources	13	4
Indoor Environmental Quality	15	6
LEED Innovation Credits	5	3
Total	69	25
Certification	None	

While the building's score of twenty-five points would not be high enough to obtain certification, it's worth noting (as seen in Appendix A) that numerous additional points could be possible. Increased Ventilation, Outdoor Air Delivery Monitoring, and Optimize Energy performance are three areas where the building mechanical system designer could certainly have an impact in altering the building's design to possibly obtain more points. The design engineering team would have to carefully weigh the added first costs, expenses, and work required to obtain these points against the desire to become LEED Certified.

3.0 Building Envelope Compliance

ASHRAE Standard 90.1-2004 requires one of two methods be used to determine the level of compliance of a building envelope system. The two methods are the Prescriptive Building Envelope Option and the Building Envelope Trade-Off Option. The Prescriptive Building Envelope Option may be used provided that the vertical fenestration area does not exceed 50% of the gross wall area and the skylight fenestration area does not exceed 5% of the gross wall area. The HBCCH does not utilize a skylighting system, so that requirement was immediately met. It was determined that the vertical fenestration area was 24.24% of the gross wall area, meaning that the Prescriptive Building Envelope Option may be used for the remainder of this analysis. The results of the vertical fenestration area calculation can be seen below in Table-3.

Table-3: Vertical Fenestration Area Calculation

Building	Elevation	Window Area	Total Area	%
East	N	4074	9696	42.02
East	S	2893	12536	23.08
East	E	2072	11935	17.36
East	W	4754	11625	40.89
West	N	14555	64323	22.63
West	S	16139	64561	25.00
West	E	11939	42934	27.81
West	W	6256	40990	15.26
Total		62682	258600	24.24

Table B-1 of Appendix B in ASHRAE Standard 90.1-2004 was used in order to determine the climate zone of the HBCCH. Located in downtown Baltimore, Maryland, the HBCCH is part of climate zone 4A. It is also necessary to know the correct Space-Conditioning Category. All areas of the HBCCH are considered nonresidential conditioned spaces.

Now that these classifications are known, Table 5.5-4 of ASHRAE Standard 90.1-2004 can now be used to check the compliance of both fenestration and opaque elements. The results of this analysis can be seen below in Table-4 and Table-5.

Table-4: Fenestration Compliance

	ASHRAE 90.1-2004		Design Conditions		
Vertical Glazing % of Wall	Assembly Max U Value (Fixed/Operable)	Assembly Max SHGC (All Orientations/North)	Assembly Max U Value (Fixed/Operable)	Assembly Max SHGC (All Orientations/North)	Complies?
20.1-30.0	0.57	0.39	0.57	0.39	YES
	0.67	0.49	0.57	0.39	YES

Table-5: Opaque Elements Compliance

	ASHRAE 90.1-2004		Design Conditions		
Opaque Elements	Assembly Max U Value (Fixed/Operable)	Insulation Min R Value	Assembly Max U Value (Fixed/Operable)	Insulation Min R Value	Complies?
Roof					
Insulation Entirely Above Deck	0.063	15	0.063	15	YES
Walls, Above Grade					
Metal Building	0.113	13	0.113	13	YES
Floors					
Mass	0.107	6.3	0.117	0	NO

All but one of the building envelope elements complies with ASHRAE Standard 90.1-2004. The element which does not comply, the mass flooring, mainly fails because no insulation is used.

It is important to note that the values under the design conditions portion of Table-4 and Table-5 exactly match the values in the ASHRAE 90.1-2004 column for all elements except for flooring. Construction of the HBCCH is ongoing, and the specifications for the project simply state that building envelope components much be equal to or greater than the minimum requirement for compliance with this standard. Actual data on the final building envelope system selected is still not available at this time.

4.0 HVAC Systems Compliance

Economizers:
Section 6.5.1 of ASHRAE Standard 90.1-2004 requires that each cooling system with a fan meet the guidelines listed in Table 6.5.1 for economizers. The guidelines are based on climate zone and the cooling capacity of the system. Located in climate zone 4A, none of the systems at the HBCCH require economizers, however all systems do have them.

Fan Power Limitation:
In an effort to limit the amount of energy being used by the fans in a building, Section 6.5.3.1 establishes the maximum allowable nameplate horsepower a fan can have based on horsepower per 1000 cfm limits. Variable volume systems have higher allowable rates than constant volume systems. A compliance summary for the fans in the HBCCH can be seen below in Table-6.

Table-6: Fan Power Limitation

System	Supply CFM	Allowable Nameplate hp/1000cfm	Allowable Nameplate hp	Design Nameplate hp	Complies?
MAU 1	34000	1.1	37.4	40	NO
MAU 2	23000	1.1	25.3	30	NO
MAU 3	21000	1.1	23.1	20	YES
MAU 4	8000	1.2	9.6	10	NO
AHU 1	31000	1.5	46.5	40	YES
AHU 2	31000	1.5	46.5	40	YES
AHU 3	38000	1.5	57	40	YES
AHU 4	26000	1.5	39	40	NO
AHU 5	47000	1.5	70.5	50	YES
AHU 6	48500	1.5	72.75	50	YES
AHU 7	48500	1.5	72.75	50	YES
AHU 8	4000	1.7	6.8	7.5	NO
PAC 1	5300	1.7	9.01	3	YES

Eight of the thirteen fans comply with ASHRAE Standard 90.1-2004. It's worth noting that the fans which did not comply would have complied if their brake horsepower values were used instead of their nameplate horsepower values.

Kitchen Exhaust Hoods:
Section 6.5.7.1 of ASHRAE Standard 90.1-2004 requires that all kitchen exhaust hoods larger than 5,000 cfm be provided with makeup air sized for at least 50% of the exhaust air volume. The two main kitchens in the HBCCH are both supplied with enough makeup air from makeup air units (MAU) 3 and 4 to satisfy this requirement

Chillers and Boilers:
The HBCCH receives chilled water and steam from two district services. There are no onsite chillers or boilers.

5.0 Lighting Compliance

ASHRAE Standard 90.1-2004 lists two methods for lighting system compliance. The two methods are the Building Area Method and the Space-by-Space method. The Building Area Method is a simplified approach which forces the design engineer to classify the entire area of the building as one type of space. A more flexible method, the Space-by-space method allows the user to classify each individual space separately.

For this report, the Space-by-Space method prescribed in ASHRAE Standard 90.1-2004 was applied to the lighting system of the HBCCH. Each space was classified so that a matching Allowable Lighting Power Density (LPD) could be compared to the actual LPD of the spaces. The results of the compliance analysis can be seen in Table-7 below.

Table-7: Lighting Compliance

LOCATION	Area (ft^2)	Total Wattage	LP Density (w/ft^2)	Allowable LPD (w/ft^2)	Complies?
Level 1 West					
Lobby	16200	40629	2.5	1.3	NO
Corridor and Support	5346	4236	0.8	0.5	NO
Storage	3987	3190	0.8	0.8	NO
Kitchen	448	896	2.0	1.2	NO
Office	3932	5674	1.4	1.1	NO
Mezzanine West					
Hotel Function	2078	1943	0.9	1.1	YES
Corridor and Support	4539	3300	0.7	0.5	NO
Office	4996	6724	1.3	1.1	NO
Level 2 West					
Hotel Function	57789	132573	2.3	1.1	NO
Kitchen	9020	10824	1.2	1.2	YES
Storage	1204	1020	0.8	0.8	NO
Corridor and Support	9379	7570	0.8	0.5	NO
Office	180	270	1.5	1.1	NO
Level 3 West					
Storage	4335	2858	0.7	0.8	YES
Hotel Function	22676	50211	2.2	1.1	NO
Office	526	516	1.0	1.1	YES
Corridor and Support	600	794	1.3	0.5	NO
Level 1 East					
Kitchen	2752	4570	1.7	1.2	NO
Lobby	9272	26047	2.8	1.3	NO
Storage	304	380	1.3	0.8	NO

LOCATION	Area (ft²)	Total Wattage	LP Density (w/ft²)	Allowable LPD (w/ft²)	Complies?
Corridor and Support	2439	1622	0.7	0.5	NO
Hotel Function	7100	16920	2.4	1.1	NO
Office	382	360	0.9	1.1	YES
Level 2 East					
Hotel Function	31604	77153	2.4	1.1	NO
Storage	2328	2208	0.9	0.8	NO
Corridor and Support	1350	1060	0.8	0.5	NO
Typical Hotel Guest Room					
King Bed Room	269	280	1.0	1.1	YES
Double Bed Room	259	280	1.1	1.1	YES

The majority of the spaces in the HBCCH failed to comply with the lighting section of ASHRAE Standard 90.1-2004. Upon consultation with the building's lighting designer, it was found that the City of Baltimore required the design to comply with the 2000 version of the International Energy Efficiency Code (IEEC). This code lists higher allowable LPDs than ASHRAE Standard 90.1-2004, and the system would comply with IEEC-2000.

6.0 Lost Rentable Space

Rentable space is one of the most valuable aspects of a commercial building, so it is important for the building mechanical system design engineer to consider the amount of space lost due to the building's mechanical system. Minimizing this loss creates more usable space which in turn creates increased profit.

The amount of rentable space lost in the HBCCH was calculated by totaling the areas of all mechanical spaces and shafts. A total of 19,932 sq ft of rentable space was lost due to the building mechanical system, or roughly 3% of the building's total rentable space. See Table-8 (below) for a detailed breakdown of where the space was lost.

Table-8: Lost Rentable Space Breakdown

Type	Room #	Space	Area (sq ft)
Room	1M91	Mechanical	3035
Room	B101	Mechanical	1100
Room	301	Mechanical	4733
Room	1M27	Mechanical	2079
Room	B108	Plumbing Equipment	335
Shaft	NA	Higher Guest Room Tower Shafts	2720
Shaft	NA	Lower Guest Room Tower Shafts	1210
Shaft	NA	VFCU's in Guest Rooms	3280
Shaft	NA	Podium Shafts	1440
		Total Lost Area:	19932
		Total Building Area:	648000
		Percent Lost Rentable Space:	3.08

The amount of space lost to mechanical rooms is relatively small compared to the size of the HBCCH. This is mainly due to the fact that the building utilizes district chilled water and steam. There are no boilers, chillers, or related equipment on site. Furthermore, five of the building's large Air Handling Units (AHU) are located on rooftops. One of the largest areas of lost rentable space is incurred when totaling the space lost by the Vertical Fan Coil Units (VFCU) in each of the hotel guest rooms. Each VFCU takes up a 4 sq ft area of space in the corner of the room.

7.0 Mechanical System First Cost

The estimated total cost for the HBCCH is $250 million. Of that price, roughly $16.8 million is expected to be mechanical system first cost. This price equates to roughly $26 per sq ft. A detailed breakdown of the mechanical system first cost can be seen below in Table-9. It's important to note that a life-cycle cost analysis of the mechanical system would most likely give a more accurate picture of how expensive the system really is. There is considerably less first cost for this system because both chilled water and steam are on district systems. The tradeoff is paying for the chilled water and steam throughout the life of the system.

Table-9: Mechanical System First Cost

Cost Type	Cost
Sheet Metal Labor	$3,530,000
Sheet Metal Materials	$980,000
Pipe Fitting Labor	$2,040,000
Pipe Fitting Materials	$760,000
Start/Test	$140,000
HVAC Equipment	$2,540,000
Subs	$2,520,000
Other	$4,295,000
Total Mechanical System First Cost	$16,805,000
Total Square Footage	648,000
Total Mechanical System First Cost Per Sq Ft	$25.93

8.0 Load Estimation and Comparison

Many factors, including internal thermal generation and heat gain through the building envelope, contribute to a building's design cooling load. Internal thermal generation loads come from things such as people, lighting, plug loads, and mechanical and electrical systems. At the same time, solar gain would be an example of a cooling load occurred through the building envelope. For the purpose of this report, Trane TRACE was used to calculate the design cooling load of the HBCCH. Heating and electrical loads were also calculated.

In order to accurately use Trane TRACE to estimate the building's loads, many factors had to be considered. For example, not all of the HBCCH's spaces are occupied the same way throughout the course of a typical day. Because of this, different schedules were created for different types of spaces. Hotel rooms are more heavily occupied late in the evening and overnight, while public spaces such as conference rooms tend to be occupied during the typical eight to five work day. A complete breakdown of the schedules used can be found in Appendix B of this report.

Summaries of the computed loads compared to the actual designed conditions can be seen below in Table-10. A more detailed breakdown of the estimated loads can be found in Appendix C of this report. In many cases, the estimated values are quite similar to the values pulled from the design documents. Areas of inconsistency could be caused by many factors, including estimated occupancy loads, estimated equipment loads, and estimated lighting loads. The inputs associated with the portion of the load dealing with building envelope are fairly cut and dry, so they probably do not have much to do with any inconsistencies.

Table-10: Load Estimation and Comparison

System	Output	Cooling (ft^2/ton)	Supply (cfm/ft^2)	Ventilation (cfm/ft^2)
AHU 1	TRACE	332.85	0.77	0.37
	Design	250.16	0.77	0.35
AHU 2	TRACE	185.37	0.98	0.98
	Design	136.80	0.99	0.77
AHU 3	TRACE	272.85	0.88	0.51
	Design	161.23	1.19	0.50
AHU 4	TRACE	258.14	1.02	0.45
	Design	163.75	1.18	0.50
AHU 5	TRACE	70.16	3.10	2.38
	Design	56.50	3.12	1.66
AHU 6	TRACE	83.22	2.20	2.20
	Design	65.46	2.26	1.21
AHU 7	TRACE	142.07	1.41	1.17
	Design	114.69	1.40	0.75
AHU 8	TRACE	238.38	1.07	0.59
	Design	123.96	1.29	0.97
MAU 1	TRACE	194.96	0.66	0.66
	Design	287.64	0.65	0.65
MAU 2	TRACE	240.51	0.53	0.53
	Design	306.45	0.61	0.61
MAU 3	TRACE	146.92	1.96	1.96
	Design	60.99	2.17	2.17
MAU 4	TRACE	157.24	1.51	1.51
	Design	55.03	2.42	2.42

Note that the design values for cooling capacity in Table-10 were calculated by using the total capacities listed in the cooling coil schedule in the design documents.

The overall building cooling load estimated for the HBCCH was 1,975 tons. This value was then compared to the load estimated by the building mechanical system design engineers. In their first estimation, the design team concluded that the overall cooling load would be 1,850 tons. This value was later decreased to 1,645 tons using what the design engineer called "more diversity factors and some common sense."

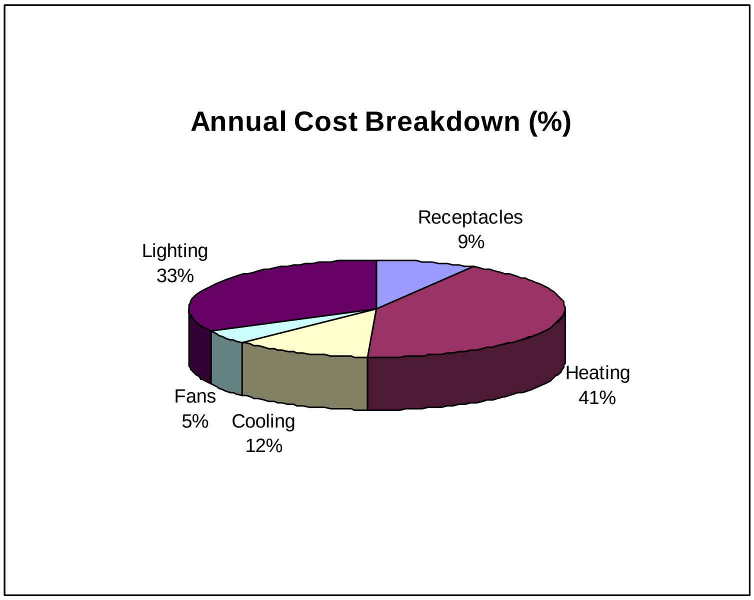
9.0 Energy and Cost Estimation and Comparison

Once again, Trane TRACE was used for this section of Technical Report #2. In order to carry out the energy and cost analysis, utility rates were found and then applied to the same Trane TRACE load estimation model used in Section 8.0 of this report. The utility rates for electricity and district chilled water are known, however the rate for district steam was not released by the owner of the district plant. All utility rates used can be found in Appendix B. Air flow rates, water flow rates, and schedules are the same as the ones used in completing the load estimation in Section 8.0 of this report.

The overall cooling cost to operate the HBCCH is $7.07 per square foot. This value, seemingly rather high at first glance, is expensive due to the fact that the building purchases chilled water from a district system. This high cost is offset by the fact that the building mechanical system had a very low first cost and will have very low maintenance costs.

The results of the energy and cost analysis can be seen below in Figure-1 and more detailed results can be seen in the Trane TRACE output files found in Appendix C of this report.

Figure-1: Annual Cost Breakdown



Because the HBCCH is still under construction, no yearly energy utilization data could be compiled for comparison. Furthermore, the building design engineer has not yet completed an energy analysis, however one is apparently being considered in the near future. These two facts make it very difficult to put the results of this report's energy and cost estimation into perspective.

After completing the energy and cost analysis and reviewing the results, it is increasingly clear that something is not correct in the overall annual cost breakdown. Heating costs should not be the highest energy cost for a multi-use facility in downtown Baltimore, Maryland. Numerous attempts were made to find an error in the heating portion of the building load estimation program used in Section 8.0 of this report, but none could be found. It is obvious that further work and hopefully future comparison with the building design engineer's energy analysis need to be carried out to eliminate this issue before any alternatives or redesigns are carried out in the spring.

10.0 References

1. ASHRAE Standard 90.1-2004.
2. LEED-NC Version 2.2
3. MC Dean, Electrical Drawings and Specifications.
4. Southland Industries, Mechanical Drawings and Specifications.
5. Mike McLaughlin and Andrew Tech, Thesis Consultants, Southland Industries.
6. The Pennsylvania State University Architectural Engineering Department, Thesis Advisor: Dr. William Bahnfleth.
7. Baltimore Gas and Electric Utility Rates
8. Dennis Manning, General Manager, ComfortLink district chilled water plant
9. Past Thesis Technical Reports, e-Studio Archives, 2004-2005.

Appendix A – LEED Registered Project Checklist

LEED-NC Version 2.2 Registered Project Checklist

The Hilton Baltimore Convention Center Hotel

Yes	?	No			
7	**5**	**2**		**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 and 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 Management**, Quantity Control	1
		1	Credit 6.2	**Stormwater Management**, 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

Yes	?	No			
4	**2**	**11**		**Energy & Atmosphere**	**17** Points

Yes	?	No			
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundimental Refrigerant Management**	Required
4	2	4	Credit 1	**Optimize Energy Performance**	1 to 10
		3	Credit 2	**On-Site Renewable Energy**	1 to 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	1	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 Interiorr 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 post-industrial)	1
	1		Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ post-industrial)	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			
6	4	5		**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

Yes	?	No	Credit	Description	Points
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**, Verication	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			
3		2		**Innovation & Design Process**	**5** Points
1			Credit 1.1	**Innovation in Design**: Education Program	1
1			Credit 1.2	**Innovation in Design**: O&M Materials	1
		1	Credit 1.3	**Innovation in Design**: None	1
		1	Credit 1.4	**Innovation in Design**: None	1
1			Credit 2	**LEED™ Accredited Professional**	1

Yes	?	No			
25	13	31		**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 – TRACE Input Information

Schedules:
Hilton Hotels supplied the design engineering team with the following schedules

People – Hotel General

Start Time	End Time	%
Midnight	9 a.m.	70.0
9 a.m.	10 a.m.	50.0
10 a.m.	4 p.m.	30.0
4 p.m.	5 p.m.	50.0
5. p.m.	Midnight	70.0

Lights – Hotel General

Start Time	End Time	%
Midnight	6 a.m.	50.0
6 a.m.	7 a.m.	80.0
7 a.m.	5 p.m.	100.0
5 p.m.	10 p.m.	80.0
10 p.m.	Midnight	50.0

People – Hotel Lobby

Start Time	End Time	%
Midnight	7 a.m.	20.0
7 a.m.	8 a.m.	80.0
8 a.m.	9 a.m.	100.0
9 a.m.	9 p.m.	60.0
9 p.m.	Midnight	20.0

Lights – Hotel Lobby

Start Time	End Time	%
Midnight	6 a.m.	50.0
6 a.m.	7 a.m.	80.0
7 a.m.	5 p.m.	100.0
5 p.m.	10 p.m.	80.0
10 p.m.	Midnight	50.0

People – Hotel Dining Room

Start Time	End Time	%
Midnight	6 a.m.	0.0

6 a.m.	8 a.m.	50.0
8 a.m.	9 a.m.	100.0
9 a.m.	10 a.m.	80.0
10 a.m.	11 a.m.	20.0
11 a.m.	noon	80.0
noon	1 p.m.	100.0
1 p.m.	5 p.m.	20.0
5 p.m.	8 p.m.	100.0
8 p.m.	9 p.m.	10.0
9 p.m.	Midnight	0.0

Lights – Hotel Dining Room

Start Time	End Time	%
Midnight	5 a.m.	0.0
5 a.m.	6 a.m.	50.0
6 a.m.	9 p.m.	100.0
9 p.m.	10 p.m.	50.0
10 p.m.	Midnight	0.0

People – Hotel Ballroom

Start Time	End Time	%
Midnight	11 a.m.	0.0
11 a.m.	3 p.m.	100.0
3 p.m.	5 p.m.	20.0
5 p.m.	10 p.m.	100.0
10 p.m.	11 p.m.	20.0
11 p.m.	Midnight	0.0

Lights – Hotel Ballroom

Start Time	End Time	%
Midnight	11 a.m.	0.0
11 a.m.	3 p.m.	100.0
3 p.m.	5 p.m.	50.0
5 p.m.	10 p.m.	100.0
10 p.m.	11 p.m.	20.0
11 p.m.	Midnight	0.0

Hotel Prefunction

Start Time	End Time	%
Midnight	10 a.m.	0.0
10 a.m.	11 a.m.	100.0
11 a.m.	4 p.m.	20.0
4 p.m.	5 p.m.	100.0
5 p.m.	10 p.m.	20.0
10 p.m.	Midnight	30.0

People - Hotel Meeting Rooms

Start Time	End Time	%
Midnight	7 a.m.	0.0
7 a.m.	8 a.m.	20.0
8 a.m.	noon	100.0
noon	1 p.m.	20.0
1 p.m.	5 p.m.	100.0
5 p.m.	8 p.m.	30.0
8 p.m.	Midnight	10.0

Lights - Hotel Meeting Rooms

Start Time	End Time	%
Midnight	7 a.m.	0.0
7 a.m.	5 p.m.	100.0
5 p.m.	8 p.m.	50.0
8 p.m.	Midnight	20.0

People – Retail Store

Start Time	End Time	%
Midnight	8 a.m.	0.0
8 a.m.	9 a.m.	10.0
9 a.m.	10 a.m.	30.0
10 a.m.	11 a.m.	60.0
11 a.m.	4 p.m.	100.0
4 p.m.	5 p.m.	80.0
5 p.m.	9 p.m.	40.0
9 p.m.	10 p.m.	10.0
10 p.m.	Midnight	0.0

Lights – Retail Store

Cooling Design

Start Time	End Time	%

Midnight	8 a.m.	10.0
8 a.m.	9 a.m.	80.0
9 a.m.	9 p.m.	100.0
9 p.m.	10 p.m.	20.0
10 p.m.	Midnight	10.0

People – Low Rise Office

Start Time	End Time	%
Midnight	7 a.m.	0.0
7 a.m.	8 a.m.	30.0
8 a.m.	11 a.m.	100.0
11 a.m.	noon	80.0
noon	1 p.m.	40.0
1 p.m.	2 p.m.	80.0
2 p.m.	5 p.m.	100.0
5 p.m.	6 p.m.	30.0
6 p.m.	9 p.m.	10.0
9 p.m.	Midnight	5.0

Lights – Low Rise Office

Start Time	End Time	%
Midnight	7 a.m.	5.0
7 a.m.	8 a.m.	80.0
8 a.m.	10 a.m.	90.0
10 a.m.	noon	95.0
noon	2 p.m.	80.0
2 p.m.	4 p.m.	90.0
4 p.m.	5 p.m.	95.0
5 p.m.	6 p.m.	80.0
6 p.m.	7 p.m.	70.0
7 p.m.	8 p.m.	60.0
8 p.m.	9 p.m.	40.0
9 p.m.	10 p.m.	30.0
10 p.m.	Midnight	20.0

People – Hotel Rooms

Start Time	End Time	%
Midnight	9 a.m.	100.0
9 a.m.	11 a.m.	20.0
11 a.m.	5 p.m.	0.0
5 p.m.	Midnight	100.0

Lights – Hotel Rooms

Start Time	End Time	%
Midnight	6 a.m.	5.0
6 a.m.	9 a.m.	100.0
9 a.m.	11 a.m.	50.0
11 a.m.	5 p.m.	0.0
5 p.m.	9 p.m.	100.0
9 p.m.	Midnight	5.0

Utility Rates:

The rates for ComfortLink chilled water and Baltimore Gas and Electric are known rates, but the rate for Trigen district steam was not released by Trigen so a rate was assumed.

ComfortLink Chilled Water:

Capacity Charge: $210/ton of capacity every month
Usage Charge: $0.15/tonhr of usage every month

Baltimore Gas and Electric:

Customer Charge: $110/month
Demand Charge: $1.05/kW
Delivery Charge: $2.67/kW
Energy Charge (Summer): $0.08802/kWh
Energy Charge (Non-Summer): $0.05406/kWh

Trigen Steam: (Assumed Rate)

Usage Charge: $1.30/therm

Appendix C – TRACE Output Files

EQUIPMENT ENERGY CONSUMPTION

By ae

Alternative: 1 Hilton Baltimore Convention Center Hotel

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
	------- Monthly Consumption -------												
Lights													
Electric (kWh)	451,487.3	407,800.0	451,805.8	436,871.9	451,646.6	437,190.4	451,328.0	451,805.8	436,871.9	451,646.4	437,031.1	451,328.1	5,316,813.5
Peak (kW)	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8	1,195.8
MISC LD													
Electric (kWh)	116,467.9	105,202.3	116,805.7	112,656.4	116,636.8	112,994.2	116,299.0	116,805.7	112,656.4	116,636.8	112,825.3	116,299.0	1,372,285.3
Peak (kW)	182.0	182.0	182.0	182.0	182.0	182.0	182.0	182.0	182.0	182.0	182.0	182.0	182.0
AHU-01													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	1,834.5	1,685.0	2,087.1	2,261.1	3,984.6	5,583.6	7,028.5	5,631.9	3,934.6	2,418.6	2,190.8	1,978.7	40,619.1
Peak (kW)	3.1	3.3	4.0	6.1	13.2	23.2	29.7	23.3	17.4	7.2	4.9	3.9	29.7
AHU-02													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	2,502.2	2,306.6	2,608.2	2,610.9	3,695.9	4,388.3	5,038.9	4,354.6	3,543.9	2,707.9	2,558.6	2,577.4	38,893.3
Peak (kW)	6.2	6.9	9.5	12.8	21.5	25.6	29.6	25.5	22.5	11.7	9.1	7.1	29.6
AHU-03													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	1,720.7	1,603.3	1,896.1	2,052.2	3,230.3	4,173.1	5,091.2	4,147.9	3,213.4	2,053.5	1,872.0	1,804.1	32,857.7
Peak (kW)	3.8	3.8	4.9	6.5	15.8	22.8	26.9	23.9	20.5	7.1	6.1	3.8	26.9
AHU-04													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	1,377.0	1,252.3	1,438.9	1,499.9	2,221.7	2,893.4	3,562.1	2,782.4	2,120.6	1,527.4	1,423.3	1,407.0	23,506.0
Peak (kW)	2.2	2.3	2.6	3.9	11.2	16.8	21.6	16.8	13.6	4.2	2.9	2.3	21.6
AHU-05													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	2,881.3	2,595.4	2,946.1	2,884.8	3,102.5	3,037.8	3,168.1	3,142.1	3,029.4	3,013.0	2,879.2	2,892.3	35,572.0
Peak (kW)	36.6	36.7	38.6	39.5	42.2	43.6	44.9	44.2	43.5	40.4	39.5	37.4	44.9
AHU-06													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	2,599.4	2,348.3	2,631.9	2,569.3	2,773.3	2,767.2	2,924.4	2,865.0	2,719.7	2,660.1	2,557.3	2,611.2	32,027.0
Peak (kW)	31.0	32.2	35.9	38.0	41.8	43.8	45.3	44.7	44.2	40.2	36.5	32.4	45.3

EQUIPMENT ENERGY CONSUMPTION
By ae

Alternative: 1 Hilton Baltimore Convention Center Hotel

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
	------- Monthly Consumption -------												
AHU-07													
AF Centrifugal var freq drv (Main Clg Fan)													
Electric (kWh)	2,695.4	2,460.6	2,764.7	2,703.0	2,915.6	2,957.8	3,149.8	3,022.6	2,825.5	2,790.2	2,680.8	2,736.6	33,702.5
Peak (kW)	24.2	25.9	27.5	32.8	38.3	42.5	46.8	41.8	39.4	33.0	30.2	27.6	46.8
Cpl 1: Comfort Link Chilled Water [Sum of dsn coil capacities=2,076 tons]													
Air-cooled chiller - 001 [Nominal Capacity=2,076 tons] (Cooling Equipment)													
Purc. Chill Water (therms)	1,171.2	1,059.2	1,412.7	1,938.4	5,207.4	8,705.5	12,391.0	9,438.7	6,000.2	2,310.8	1,811.0	1,192.4	52,638.4
Peak (therms/Hr)	1.8	1.8	5.2	8.4	20.0	31.9	34.9	31.6	24.1	11.0	8.8	3.6	34.9
Cooling tower for Cent. Chillers													
Electric (kWh)	28,132.8	25,415.6	28,199.7	27,656.7	32,453.0	38,333.7	47,024.8	40,198.7	33,056.5	28,894.8	27,462.8	28,131.6	384,960.8
Peak (kW)	37.8	37.8	40.0	44.2	62.9	96.5	112.4	93.5	72.0	46.5	43.3	38.2	112.4
Cooling tower for Cent. Chillers													
Make Up Water (1000gal)	242.4	219.2	292.4	401.2	1,077.8	1,801.8	2,564.6	1,953.6	1,241.9	478.3	374.8	246.8	10,894.7
Peak (1000gal/Hr)	0.4	0.4	1.1	1.7	4.1	6.6	7.2	6.5	5.0	2.3	1.8	0.8	7.2
Cpl 2: Electric Cooling [Sum of dsn coil capacities=12.36 tons]													
Air-cooled unitary - 002 [Nominal Capacity=12.36 tons] (Cooling Equipment)													
Electric (kWh)	1,753.5	1,559.0	2,223.6	2,530.4	3,763.2	4,589.6	5,477.4	4,798.6	3,921.3	2,663.4	2,375.2	1,993.0	37,648.2
Peak (kW)	12.8	12.8	13.4	13.9	15.8	16.7	17.1	16.5	16.0	14.3	13.9	12.9	17.1
Condenser fan for Heat Pump													
Electric (kWh)	262.6	233.5	332.2	374.1	524.4	617.5	720.5	644.7	539.9	390.7	351.5	298.5	5,290.1
Peak (kW)	0.4	0.5	0.7	0.7	1.0	1.3	2.1	1.3	1.2	0.8	0.7	0.6	2.1
Cntl panel & interlocks - 0.1 KW (Misc Accessory Equipment)													
Electric (kWh)	74.4	67.2	74.4	72.0	74.4	72.0	74.4	74.4	72.0	74.4	72.0	74.4	876.0
Peak (kW)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hpl 1: Trigen Steam Heating [Sum of dsn coil capacities=1,384,680 mbh]													
Boiler - 001 [Nominal Capacity=1,384,680 mbh] (Heating Equipment)													
Purchased Steam (therms)	43,258.7	39,986.4	24,759.0	14,982.3	6,693.4	7,239.3	9,826.6	7,959.4	6,325.8	14,225.3	17,567.6	33,671.9	226,495.6
Peak (therms/Hr)	84.4	82.7	63.1	41.4	26.5	28.9	25.9	27.8	26.4	41.1	50.2	65.2	84.4
Eq5061 - Condensate return pump (Misc Accessory Equipment)													
Electric (kWh)	778.6	703.3	713.7	596.5	389.3	389.3	584.0	454.2	359.0	584.0	627.9	778.6	6,958.2
Peak (kW)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

EQUIPMENT ENERGY CONSUMPTION
By ae

Alternative: 1   Hilton Baltimore Convention Center Hotel

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
					------- Monthly Consumption -------								
Hpl 2: Electric Heating [Sum of dsn coil capacities=69,063 mbh]													
Electric Resistance - 002 [Nominal Capacity=69,063 mbh] (Heating Equipment)													
Electric (kWh)	75,976.6	68,458.5	16,879.0	314.1	0.0	0.0	0.0	0.0	0.0	551.1	3,787.4	41,728.2	207,694.8
Peak (kW)	209.9	220.0	89.9	28.8	0.0	0.0	0.0	0.0	0.0	25.9	32.6	121.1	220.0
MAU-01													
AF Centrifugal const vol (Main Clg Fan)													
Electric (kWh)	20,070.9	18,128.5	20,070.9	19,423.4	20,070.9	19,423.4	20,070.8	20,070.9	19,423.4	20,070.9	19,423.4	20,070.9	236,318.3
Peak (kW)	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0
MAU-02													
AF Centrifugal const vol (Main Clg Fan)													
Electric (kWh)	11,715.9	10,582.1	11,715.9	11,338.0	11,715.9	11,338.0	11,715.9	11,715.9	11,338.0	11,715.9	11,338.0	11,715.9	137,945.3
Peak (kW)	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
MAU-03													
AF Centrifugal const vol (Main Clg Fan)													
Electric (kWh)	7,853.3	7,093.3	7,853.3	7,600.0	7,853.3	7,600.0	7,853.3	7,853.3	7,600.0	7,853.3	7,600.0	7,853.3	92,466.7
Peak (kW)	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
MAU-04													
AF Centrifugal const vol (Main Clg Fan)													
Electric (kWh)	2,066.7	1,866.7	2,066.7	2,000.0	2,066.7	2,000.0	2,066.7	2,066.7	2,000.0	2,066.7	2,000.0	2,066.7	24,333.3
Peak (kW)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

ENERGY CONSUMPTION SUMMARY

By ae

	Elect Cons. (kWh)	PCldW Cons. (kBtu)	Water Cons. (1000 gals)	P.Stm Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Primary heating							
Primary heating	207,695			22,649,562	42.1 %	23,358,424	32,326,216
Other Htg Accessories	6,958				0.0 %	23,748	71,252
Heating Subtotal	**214,653**			**22,649,562**	**42.2** %	**23,382,173**	**32,397,468**
Primary cooling							
Cooling Compressor	37,648	5,263,839			9.7 %	5,392,332	4,434,626
Tower/Cond Fans	390,251		10,895		2.4 %	1,331,926	3,996,179
Condenser Pump					0.0 %	0	0
Other Clg Accessories	876				0.0 %	2,990	8,970
Cooling Subtotal....	**428,775**	**5,263,839**	**10,895**		**12.1** %	**6,727,249**	**8,439,775**
Auxiliary							
Supply Fans	728,241				4.5 %	2,485,487	7,457,206
Pumps					0.0 %	0	0
Stand-alone Base Utilities					0.0 %	0	0
Aux Subtotal....	728,241				4.5 %	2,485,487	7,457,206
Lighting							
Lighting	5,316,813				32.7 %	18,146,283	54,444,292
Receptacle							
Receptacles	1,372,285				8.5 %	4,683,610	14,052,233
Cogeneration							
Cogeneration					0.0 %	0	0
Totals							
Totals**	**8,060,767**	**5,263,839**	**10,895**	**22,649,562**	**100.0** %	**55,424,799**	**116,790,968**

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

MONTHLY UTILITY COSTS

By ae

Alternative: 1

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
					------- Monthly Utility Costs -------								
Electric													
On-Pk Cons. ($)	51,368	46,405	47,368	44,771	46,948	46,334	48,632	47,880	45,556	46,332	44,984	48,994	565,574
On-Pk Demand ($)	5,954	5,956	5,875	5,932	6,155	6,367	6,610	6,367	6,194	5,947	5,895	5,835	73,086
Total ($):	57,322	52,361	53,243	50,703	53,104	52,701	55,243	54,248	51,749	52,279	50,879	54,829	638,660
Purchased Steam													
On-Pk Cons. ($)	51,910	47,984	29,711	17,979	8,032	8,687	11,792	9,551	7,591	17,070	21,081	40,406	271,795
Purchased Chilled Water													
On-Pk Cons. ($)	416,214	416,074	416,515	417,172	421,258	425,629	430,235	426,546	422,248	417,638	417,013	416,240	5,042,782
Monthly Total ($):	525,446	516,418	499,469	485,854	482,393	487,018	497,270	490,345	481,589	486,987	488,973	511,475	5,953,237

ELECTRICAL PEAK CHECKSUMS

By ae

Alternative: 1 Hilton Baltimore Convention Center Ho
Yearly Time of Peak: 18(Hr) 7(Month)

Equipment Description		Electrical Demand (kw)	Percent of Total (%)
Cooling Equipment			
Air-cooled chiller - 001		99.86	5.62
Air-cooled unitary - 002		17.99	1.01
	Sub total	117.85	6.63
Fan Equipment			
Sys 1: AHU-01		29.69	1.67
Sys 2: AHU-02		29.63	1.67
Sys 3: AHU-03		26.94	1.52
Sys 4: MAU-03		10.56	0.59
Sys 7: AHU-07		46.83	2.64
Sys 6: MAU-04		2.78	0.16
Sys 5: AHU-06		45.34	2.55
Sys 8: AHU-05		44.92	2.53
Sys 9: AHU-04		21.58	1.21
Sys 41: MAU-01		26.98	1.52
Sys 52: MAU-02		15.75	0.89
	Sub total	301.00	16.95
Miscellaneous			
Lights		1,195.76	67.29
Base Utilities		0.00	0.00
Misc Equipment		162.33	9.14
	Sub total	1,358.09	76.43
	Total	1,776.94	100

SYSTEM SUMMARY

DESIGN AIRFLOW QUANTITIES

By ae

System Description	System Type	MAIN SYSTEM Outside Airflow cfm	Cooling Airflow cfm	Heating Airflow cfm	Return Airflow cfm	Exhaust Airflow cfm	Auxiliary System Supply Airflow cfm	Room Exhaust Airflow cfm
AHU-01	Variable Volume Reheat (30% Min Flow Default)	14,866	30,911	10,783	31,664	30,911	0	1,636
AHU-02	Variable Volume Reheat (30% Min Flow Default)	30,852	30,852	11,988	31,572	30,852	0	1,130
AHU-03	Variable Volume Reheat (30% Min Flow Default)	16,290	28,052	10,231	29,032	28,052	0	3,375
MAU-03	Variable Temperature Constant Volume	19,000	19,000	19,000	19,196	19,196	0	0
AHU-06	Variable Volume Reheat (30% Min Flow Default)	47,209	47,209	17,087	47,638	47,209	0	650
MAU-04	Variable Temperature Constant Volume	5,000	5,000	5,000	5,000	5,000	0	0
AHU-07	Variable Volume Reheat (30% Min Flow Default)	40,425	48,758	17,937	49,366	48,758	0	2,560
AHU-05	Variable Volume Reheat (30% Min Flow Default)	35,840	46,772	19,200	47,101	46,772	0	0
AHU-04	Variable Volume Reheat (30% Min Flow Default)	9,823	22,468	7,541	23,378	22,468	0	2,300
FCU-01	Fan Coil	0	500	500	500	0	0	0
FCU-02	Fan Coil	0	147	147	147	0	0	0
FCU-03	Fan Coil	0	193	193	203	11	0	0
FCU-04	Fan Coil	0	245	245	245	0	0	0
FCU-05	Fan Coil	71	3,529	3,529	3,706	248	0	0
FCU-06	Fan Coil	81	3,312	3,312	3,491	261	0	0
FCU-07	Fan Coil	74	3,750	3,750	3,959	283	0	0
FCU-08	Fan Coil	74	4,402	4,402	4,611	283	0	0
FCU-09	Fan Coil	47	2,198	2,198	2,324	173	0	0
FCU-10	Fan Coil	0	500	500	540	40	0	0
FCU-11	Fan Coil	0	500	500	500	0	0	0
FCU-20	Fan Coil	382	1,913	1,913	1,954	423	0	0
FCU-21	Fan Coil	274	785	785	785	274	0	0
FCU-22	Fan Coil	337	2,430	2,430	2,525	432	0	0
DX-01	Fan Coil	0	500	500	500	0	0	0
DX-02	Fan Coil	0	500	500	500	0	0	0
DX-03	Fan Coil	0	500	500	500	0	0	0
DX-04	Fan Coil	0	500	500	500	0	0	0
DX-05	Fan Coil	0	500	500	500	0	0	0
HP-03	Incremental Heat Pump	20	250	250	250	20	0	0
HP01	Water Source Heat Pump	20	250	250	250	20	0	0
DX-08	Fan Coil	0	1,153	1,153	1,242	89	0	0
HP-05	Incremental Heat Pump	83	544	544	556	95	0	12,363
DX-11	Fan Coil	106	353	353	378	130	0	106
HV-01	Ventilation and Heating	1,045	0	1,045	0	1,066	0	819
HV-02	Ventilation and Heating	1	0	947	0	100	0	237
HV-03	Ventilation and Heating	165	0	331	0	165	0	165
HV-04	Ventilation and Heating	104	0	624	0	151	0	104
UH-01	Unit Heaters	0	0	0	0	0	0	0
UH-02	Unit Heaters	0	0	16	0	0	0	0
SF-01	Ventilation and Heating	0	0	0	0	0	0	200
MAU-01	Terminal Reheat	34,685	34,685	34,685	34,875	34,685	0	34,481
VFCU A	Fan Coil	0	370	370	388	18	0	0
VFCU B	Fan Coil	0	175	175	182	7	0	0
VFCU C	Fan Coil	0	120	120	127	7	0	0

System Description	System Type	MAIN SYSTEM Outside Airflow cfm	Cooling Airflow cfm	Heating Airflow cfm	Return Airflow cfm	Exhaust Airflow cfm	Auxiliary System Supply Airflow cfm	Room Exhaust Airflow cfm
VFCU D	Fan Coil	0	177	177	184	7	0	0
VFCU E	Fan Coil	0	120	120	127	7	0	0
VFCU F	Fan Coil	0	323	323	336	12	0	0
VFCU-GROUP A	Fan Coil	0	48,488	48,488	50,461	1,973	0	0
VFCU-GROUP B	Fan Coil	0	35,909	35,909	38,034	2,125	0	0
VFCU-GROUP C	Fan Coil	0	36,567	36,567	37,657	1,090	0	0
VFCU-GROUP D	Fan Coil	0	35,275	35,275	35,983	707	0	0
MAU-02	Terminal Reheat	20,246	20,246	20,246	20,424	20,246	0	19,873
AHU-08	Variable Volume Reheat (30% Min Flow Default)	1,836	3,321	1,033	3,434	1,948	0	300
PAC-01	Single Zone	1,929	2,392	2,392	2,470	2,007	0	150
VFCU G	Fan Coil	0	329	329	347	18	0	0
VFCU H	Fan Coil	0	399	399	415	16	0	0
VFCU I	Fan Coil	0	271	271	278	7	0	0
VFCU J	Fan Coil	0	273	273	281	7	0	0
VFCU K	Fan Coil	0	410	410	417	7	0	0
VFCU L	Fan Coil	0	358	358	366	7	0	0
VFCU M	Fan Coil	0	150	150	168	18	0	0
VFCU N	Fan Coil	19	146	146	153	26	0	0
VFCU O	Fan Coil	0	106	106	115	9	0	0
VFCU P	Fan Coil	12	344	344	357	24	0	0
VFCU GROUP F	Fan Coil	0	1,595	1,595	1,729	134	0	0
VFCU-GROUP E	Fan Coil	174	5,157	5,157	5,349	366	0	0
VFCU Q	Fan Coil	0	153	153	162	9	0	0
VFCU R	Fan Coil	0	139	139	147	8	0	0
VFCU S	Fan Coil	0	361	361	379	18	0	0
VFCU-GROUP F	Fan Coil	0	7,228	7,228	7,708	480	0	0
DX-07	Fan Coil	0	1,148	1,148	1,237	89	0	0
GE-11/12	Ventilation and Heating	120	0	54,945	0	120	0	54,945
GS-01/02/03/04	Ventilation and Heating	40	0	128,291	0	40	0	128,291
SF-02	Ventilation and Heating	0	0	2,500	0	0	0	2,500
GS-05/06/07/08	Ventilation and Heating	40	0	123,115	0	40	0	123,115
GE-09/10	Ventilation and Heating	40	0	40,986	0	40	0	40,986
SF-03	Ventilation and Heating	0	0	5,000	0	0	0	5,000
Totals		**281,329**	**545,213**	**740,470**	**558,902**	**349,805**	**0**	**435,287**

Note: Airflows on this report are not additive because they are each taken at the time of their respective peaks. To view the balanced system design airflows, see the appropriate Checksums report (Airflows section).

SYSTEM SUMMARY

DESIGN COOLING CAPACITIES

By ae

Building Airside Systems and Plant Capacities

Plant	System	Peak Plant Loads								Block Plant Loads								
		Main Coil ton	Aux Coil ton	Opt Vent Coil ton	Misc Load ton	Stg 1 Desic Cond ton	Stg 2 Desic Cond ton	Base Utility ton	Peak Total ton	Time Of Peak mo/hr	Main Coil ton	Aux Coil ton	Opt Vent Coil ton	Misc Load ton	Stg 1 Desic Cond ton	Stg 2 Desic Cond ton	Base Utility ton	Block Total ton
Comfort	Link Chilled Water	1,767.5	0.0	308.8	0.0	0.0	0.0	0.0	2,076.3	7/15	1,658.3	0.0	308.8	0.0	0.0	0.0	0.0	1,967.1
	AHU-01	120.8	0.0	0.0	0.0	0.0	0.0	0.0	120.8	7/15	120.8	0.0	0.0	0.0	0.0	0.0	0.0	120.8
	AHU-02	169.0	0.0	0.0	0.0	0.0	0.0	0.0	169.0	7/15	169.0	0.0	0.0	0.0	0.0	0.0	0.0	169.0
	AHU-03	116.7	0.0	0.0	0.0	0.0	0.0	0.0	116.7	7/15	116.7	0.0	0.0	0.0	0.0	0.0	0.0	116.7
	MAU-03	112.4	0.0	0.0	0.0	0.0	0.0	0.0	112.4	7/15	66.3	0.0	0.0	0.0	0.0	0.0	0.0	66.3
	AHU-06	258.2	0.0	0.0	0.0	0.0	0.0	0.0	258.2	7/15	258.2	0.0	0.0	0.0	0.0	0.0	0.0	258.2
	MAU-04	29.6	0.0	0.0	0.0	0.0	0.0	0.0	29.6	7/15	21.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0
	AHU-07	242.8	0.0	0.0	0.0	0.0	0.0	0.0	242.8	7/15	242.8	0.0	0.0	0.0	0.0	0.0	0.0	242.8
	AHU-05	214.7	0.0	0.0	0.0	0.0	0.0	0.0	214.7	7/15	214.7	0.0	0.0	0.0	0.0	0.0	0.0	214.7
	AHU-04	85.3	0.0	0.0	0.0	0.0	0.0	0.0	85.3	7/15	85.3	0.0	0.0	0.0	0.0	0.0	0.0	85.3
	FCU-01	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	FCU-02	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	FCU-03	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	FCU-04	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	7/15	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6
	FCU-05	7.6	0.0	0.0	0.0	0.0	0.0	0.0	7.6	7/15	7.1	0.0	0.0	0.0	0.0	0.0	0.0	7.1
	FCU-06	7.1	0.0	0.0	0.0	0.0	0.0	0.0	7.1	7/15	6.2	0.0	0.0	0.0	0.0	0.0	0.0	6.2
	FCU-07	7.7	0.0	0.0	0.0	0.0	0.0	0.0	7.7	7/15	6.8	0.0	0.0	0.0	0.0	0.0	0.0	6.8
	FCU-08	8.9	0.0	0.0	0.0	0.0	0.0	0.0	8.9	7/15	7.8	0.0	0.0	0.0	0.0	0.0	0.0	7.8
	FCU-09	4.7	0.0	0.0	0.0	0.0	0.0	0.0	4.7	7/15	4.6	0.0	0.0	0.0	0.0	0.0	0.0	4.6
	FCU-10	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	7/15	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1
	FCU-11	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/15	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	FCU-20	5.8	0.0	0.0	0.0	0.0	0.0	0.0	5.8	7/15	5.7	0.0	0.0	0.0	0.0	0.0	0.0	5.7
	FCU-21	2.9	0.0	0.0	0.0	0.0	0.0	0.0	2.9	7/15	2.9	0.0	0.0	0.0	0.0	0.0	0.0	2.9
	FCU-22	6.7	0.0	0.0	0.0	0.0	0.0	0.0	6.7	7/15	6.4	0.0	0.0	0.0	0.0	0.0	0.0	6.4
	MAU-01	75.5	0.0	195.0	0.0	0.0	0.0	0.0	270.4	7/15	75.2	0.0	195.0	0.0	0.0	0.0	0.0	270.2
	VFCU A	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU B	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7/15	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	VFCU C	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	VFCU D	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7/15	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	VFCU E	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	VFCU F	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU-GROUP A	53.4	0.0	0.0	0.0	0.0	0.0	0.0	53.4	7/15	37.7	0.0	0.0	0.0	0.0	0.0	0.0	37.7
	VFCU-GROUP B	67.0	0.0	0.0	0.0	0.0	0.0	0.0	67.0	7/15	60.3	0.0	0.0	0.0	0.0	0.0	0.0	60.3
	VFCU-GROUP C	36.0	0.0	0.0	0.0	0.0	0.0	0.0	36.0	7/15	27.5	0.0	0.0	0.0	0.0	0.0	0.0	27.5
	VFCU-GROUP D	32.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	7/15	19.9	0.0	0.0	0.0	0.0	0.0	0.0	19.9
	MAU-02	44.0	0.0	113.8	0.0	0.0	0.0	0.0	157.8	7/15	43.9	0.0	113.8	0.0	0.0	0.0	0.0	157.7
	AHU-08	14.7	0.0	0.0	0.0	0.0	0.0	0.0	14.7	7/15	13.4	0.0	0.0	0.0	0.0	0.0	0.0	13.4
	PAC-01	13.2	0.0	0.0	0.0	0.0	0.0	0.0	13.2	7/15	10.5	0.0	0.0	0.0	0.0	0.0	0.0	10.5
	VFCU G	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU H	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU I	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	VFCU J	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	VFCU K	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	VFCU L	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	VFCU M	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU N	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU O	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	VFCU P	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	7/15	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4
	VFCU GROUP F	4.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	7/15	4.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
	VFCU-GROUP E	6.3	0.0	0.0	0.0	0.0	0.0	0.0	6.3	7/15	6.2	0.0	0.0	0.0	0.0	0.0	0.0	6.2
	VFCU Q	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3

VFCU R	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
VFCU S	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	7/15	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
VFCU-GROUP F	10.9	0.0	0.0	0.0	0.0	0.0	0.0	10.9	7/15	10.4	0.0	0.0	0.0	0.0	0.0	0.0	10.4
Electric Cooling	12.4	0.0	0.0	0.0	0.0	0.0	0.0	12.4	7/16	8.7	0.0	0.0	0.0	0.0	0.0	0.0	8.7
DX-01	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/16	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4
DX-02	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/16	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
DX-03	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/16	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
DX-04	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/16	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
DX-05	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7/16	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
HP-03	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	7/16	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4
HP01	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	7/16	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4
DX-08	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	7/16	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2
HP-05	1.5	0.0	0.0	0.0	0.0	0.0	0.0	1.5	7/16	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7
DX-11	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	7/16	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8
DX-07	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	7/16	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2
Building totals	1,779.9	0.0	308.8	0.0	0.0	0.0	0.0	2,088.6		1,667.0	0.0	308.8	0.0	0.0	0.0	0.0	1,975.8

Building peak load is 2,088.6 tons.

Building maximum block load of 1,975.8 tons occurs in July at hour 15 based on system simulation.