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Mechanical Option
"Mechanical Technical Report #2"

The Montgomery County Conference Center and Hotel (MCCCH), Rockville, MD

Architectural renderings compliments of RTKL Associates

Mechanical Technical Report #2

Building and Plant Energy Analysis Report

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October 27, 2004

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1.0 Executive Summary:

The purpose of this report is to analyze the Montgomery County Conference Center and Hotel (MCCCH) in Rockville, MD, for its building and plant energy performance. In order to develop a model for this, MCCCH was first compared and evaluated in relation to the LEED Green Building Rating System for New Construction and Major Renovations. Other calculations and comparisons performed herein include a building energy usage and emissions analysis, building envelope and lighting compliance with ASHRAE Standard 90.1-1999, and a building lost rentable space/mechanical system first cost analysis.

The Montgomery County Conference Center and Hotel was not designed as a LEED green building and therefore, could never qualify as one. However, it was determined that the building does hold some attributes of LEED green design. The building's envelope was found to fully comply with ASHRAE Standard 90.1-1999 but, the lighting power densities throughout the building spaces did not comply with the standard. The building's lost rentable space due to mechanical equipment was about 4% of the building's total area while the mechanical system's first cost was approximately 10% of the building total cost.

Once MCCCH's energy usage characteristics were determined, building load calculations, energy analyses, and annual energy costs were calculated with the help of Carrier's Hourly Analysis Program (HAP). No simplified calculation was performed as computer generated simulations tend to have the greatest levels of accuracy. The building's required cooling capability was established and compared to the original design. It was found, in almost every case, that all of the building's original cooling design values were greater than the actual computer generated numbers. Finally, an energy analysis was run on the building simulation program. The total cost to operate the building for one year came out to be $2.429/sq. ft. or, about $424,151.

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2.0 LEED Green Building Certification:

All buildings, regardless of size, location, and how well designed, have adverse effects on the environment. These harmful effects can be both direct and indirect, beginning with the first day of construction and extending throughout the life of a building. In an attempt to assess the impacts of the Montgomery County Conference Center and Hotel (MCCCH) on its surrounding environment, the building's systems were evaluated with respect to the Leadership in Energy and Environmental Design's (LEED's) Green Building Rating System for New Construction and Major Renovations. This rating/point system was originally intended for use with office buildings but can easily be applied to all types of building construction.

In general, the U.S. Green Building Council's LEED rating system is an "effort to provide a national standard for what constitutes a 'green building'. It is used as a point-by-point design guideline and third party certification tool with an aim for improving building occupant well-being, environmental performance, and economic return. Established and innovative practices, standards, and technologies are encouraged throughout the application of the LEED point assessment system." The rating procedure itself is divided into six different categories which are sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design processes. From each of these sections, points can be earned in order to qualify a building as LEED certified, silver, gold, or platinum. LEED sections applicable to the Montgomery County Conference Center and Hotel include sustainable sites, energy and atmosphere, materials and resources, and indoor environmental quality. The following table, Table 1, lists the LEED credits obtained by MCCCH's original design.

Category	Possible Credits	Assumed Credits Received	Comments
Sustainable Sites			
Erosion and Sedimentation Control	Required	Required	Civil engineer developed a plan for different construction phases
Site Selection	1	1	Land developed was not an "inappropriate site"
Urban Redevelopment	1	1	Area developed for building was already urban
Alternative Transportation: Public Transportation Access	1	1	Project was located across the street from Washington, D.C.'s White Flint Metro Station / Metrobus stations
Energy and Atmosphere			
Fundamental Building Systems Commissioning	Required	Required	Scheduled Building Commissioning for project

Minimum Energy Performance	Required	Required	Building designed to ASHRAE/IESNA Standard 90.1 - 1999
CFC Reduction in HVAC&R Equipment	Required	Required	No CFC refrigerants used in MCCCH project
Ozone Protection	1	1	HVAC equipment does not contain HCFC's or Halons (absorption chilling implemented in project)
Materials and Resources			
Storage and Collection of Recyclables	Required	Required	Area provided for separation and recyclable collection
Indoor Environmental Quality			
Minimum IAQ Performance	Required	Required	Meets ASHRAE Standard 62 - 2001, Addendum 62n
Environmental Tobacco Smoke (ETS) Control	Required	Required	Prohibits smoking in all areas but those designated
Thermal Comfort	2	2	Complies with ASHRAE Std. 55-1992 for humidity and temperature control as well as monitors
	Total:	**6**	

(All categories and credit points taken from the LEED Green Building Rating System)

Table 1: LEED Points Acquired by MCCCH's Original Design

In order for a building to be LEED certified, it must acquire 26-32 points from the LEED rating system. The maximum amount of obtainable points is 69. Buildings that receive 33-38 points are considered LEED silver, 39-51 - LEED Gold, and 52+ - LEED Platinum. From the above analysis, it can be seen that the Montgomery County Conference Center and Hotel, with 6 LEED points, will not be LEED certified.

Other LEED credits that were not obtained by MCCCH's original design but could be very easily considered and implemented for the building project are listed below in Table 2.

Category	Possible Credits
Sustainable Sites	
Alternative Transportation: Parking Capacity	1
Reduced Site Disturbance: Development Footprint	1
Stormwater Management	2
Heat Island Effect	2
Light Pollution Reduction	1
Water Efficiency	
Water Efficient Landscaping	1

Innovative Wastewater Technologies	1
Water Use Reduction	1
Energy and Atmosphere	
Optimize Energy Performance	1 to 10
Additional Commissioning	1
Measurement and Verification	1
Materials and Resources	
Certified Wood	1
Indoor Environmental Quality	
Carbon Dioxide (CO2) Monitoring	1
Ventilation Effectiveness	1
Construction IAQ Management Plan	2
Low-Emitting Materials	4
Daylight and Views	2
Total:	**24**

(All categories and credit points taken from the LEED Green Building Rating System; Innovation in Design credits (1-5) were not considered in this table but could be added in as well)

Table 2: Additional LEED Points to consider for MCCCH

If the 24 LEED credits listed above in Table 2 were integrated into the Montgomery County Conference Center and Hotel's design, the LEED point total for the building could be 30, therefore, making the building eligible for LEED certification. However, there was no indication that LEED certification was ever an original design goal for the Montgomery County Conference Center and Hotel. The fact that certification was feasible and not pursued for this building may have a lot to do with the influence of first cost/added expenses/added work over energy conservation techniques.

3.0 Building Energy Usage / Emissions Analysis:

Another way to go about measuring a building's level of "greenness" or "environmental friendliness" is to study the magnitude of its energy usage along with the emissions produced in creating the building's consumed energy. For this section of the report on the Montgomery County Conference Center and Hotel, the building's electricity consumption, emissions from on-site electrical use (both per kilowatt-hour and total), and absorption chiller emissions will be estimated and analyzed.

Since the construction of MCCCH was not completed prior to this report, no meter data or utility bills exist for the building. Therefore, yearly energy utilization data (for both electric power and fossil fuel) could not be obtained for this section of the report and had to be estimated. In order to make the estimate as accurate as possible, the following steps were followed.

The Montgomery County Conference Center and Hotel's electricity consumption was assumed to be most similar to the combination of a public assembly space, a lodging space, and a food service space. Yearly average electricity usage per square foot for each of these three types of spaces was obtained from the "Electricity Consumption and Expenditure Intensities" data of 1999. The exact values were 12.9 kWh/sq. ft., 12.7 kWh/sq. ft., and 34.2 kWh/sq. ft. Each division of MCCCH's total area (240,000 sq.ft.) corresponding to the individual space categories was multiplied by its respective consumption intensity. The three resulting kWh values were then added up in order to obtain the total estimated yearly electricity consumption of 3,418,905 kWh for MCCCH. Table 3, below, contains a summary of the calculations used to arrive at this total. Electric and Natural Gas Rates were also obtained but will not be used until the computer energy analysis section (Section 9) of this report. All pertinent rates can be found there.

Building Category	Area of MCCCH Applicable (sq. ft.)	Average Electricity Consumption / Expenditure Intensity for given Building Category (kWh/sq. ft.)	Yearly Electricity Consumption Calculated (kWh)
Public Assembly	Conference Center and Main Hotel Areas (112,480 sq. ft.)	12.9	1450992
Food Service	Kitchen and Restaurant Spaces (16,205 sq. ft.)	34.2	554211
Lodging	Hotel Guestroom Areas (111,315 sq. ft.)	12.7	1413700.5
	MCCCH Total sq. ft. = 240,000		**MCCCH Total kWh = 3418905**

Data taken from the "Electricity Consumption and Expenditure Intensities" data of 1999.

Table 3: Estimation of MCCCH's Yearly Electricity Consumption

From the estimated yearly electricity consumption, yearly emissions (due to electricity usage only) were calculated by using data supplied by the Electric Power Annual 1999, Volume II, October 2000, DOE/EIA – 0348(99)/2, Energy Information Administration, US DOE, Washington, D.C. Yearly emissions were calculated for SO_2, NO_x, and CO_2. Information for particulates was not available.

Additionally, the source breakdown for Rockville, MD's electricity generation could not be obtained. Therefore, the average U.S. source breakdown percentages were used. Electrical transmission losses were taken into account. The final values are presented below in Table 4.

				lbm Pollutant$_j$ /kWh US					Total lbm Pollutant$_j$			
Fuel	**kWh**	**% Total**		**Particulates**	**SO_2/kWh**	**NO_x/kWh**	**CO_2/kWh**		**Particulates**	**SO_2**	**Nox**	**CO_2**
Coal	1.90E+06	55.7		N/A	1.28E-02	7.41E-03	2.15E+00		N/A	2.43E+04	1.41E+04	4.09E+06
Oil	9.36E+04	2.7		N/A	1.54E-02	2.83E-03	2.11E+00		N/A	1.44E+03	2.65E+02	1.98E+05
Nat. Gas	3.19E+05	9.3		N/A	1.35E-05	2.54E-03	1.34E+00		N/A	4.31E+00	8.10E+02	4.28E+05
Nuclear	7.81E+05	22.8		N/A	0.00E+00	0.00E+00	0.00E+00		N/A	0.00E+00	0.00E+00	0.00E+00
Hydro/Wind	3.23E+05	9.4		N/A	0.00E+00	0.00E+00	0.00E+00		N/A	0.00E+00	0.00E+00	0.00E+00
Totals	**3.42E+06**	100.0		N/A	7.54E-03	4.44E-03	1.38E+00		N/A	**2.58E+04**	**1.52E+04**	**4.72E+06**
				Taking into account a transmission efficiency of 0.9, total emissions =						**2.86E+04**	**1.69E+04**	**5.24E+06**

Data taken from the Electric Power Annual 1999, Volume II, October 2000, DOE/EIA-0348(99)/2, Energy Information Administration, US DOE, Washington, D.C.

Table 4: Estimated Emissions for MCCCH's On-site Electricity Usage

Another way that MCCCH's total energy usage/emissions were determined was by using Carrier's Hourly Analysis Program. With HAP, full building simulation can be performed and building energy consumption estimated. This was done for MCCCH (following the above calculation) in Section 9.0 of this report. The results yielded an annual energy usage of about 2,136,866 kWh, which is significantly lower than the above energy consumption total of 3,418,905 kWh. Carrier's HAP is most likely the more accurate of the two processes for estimating the building's energy consumption and therefore, the amount of emissions should probably be a lot lower than the values given in the table above. Regardless, though, the overall calculation processes would remain the same and if need be, new calculations can be made using the HAP output. The HAP program could also be further defined to provide even more accurate output. (See Appendix B for HAP output)

Emissions from the building's two BROAD USA direct fired absorptions chillers were also estimated for this section of the report. With the help of the absorption chiller's burner manufacturer, Weishaupt Burners, a calculation process for estimating the emissions from the chillers was determined. The burner manufacturer's representative, Frank Brown, Canada, was familiar with the MCCCH project.

The two BROAD absorption chillers in MCCCH are capable of running on both natural gas and oil. Therefore, emissions caused by both fuels where analyzed for this report, (see table below). A short outline of the calculation process is also carried out below.

For the Weishaupt burners on MCCCH's absorption chillers…

Natural Gas: (at 3% oxygen in the flue gas)
NOx: 30 ppm x 2.058 mg/kWh = 61.74 mg/kWh or 1.36 ^(-4) lbm/kWh
SOx: zero

#2 Oil (at 3% oxygen in the flue gas)

NOx: 250 ppm x 2.109 mg/kWh = 527.25 mg/kWh or 1.16 ^(-3) lbm/kWh
SOx: 250 mg/kWh or 5.5 ^(-4) lbm/kWh (This value depends on the sulfur content of the fuel. For this report, the sulfur content was assumed to be 0.15% by mass. However, there is a linear relationship, and at 0.20%, the SOx emission is 325 mg/kWh.)

CO2 emissions depend on the efficiency of the burners. (Paradoxically, the instantaneous rate of CO2 emission is higher in an efficient burner than in a less efficient burner. However, more fuel must be burnt to produce the same heat output if the instantaneous rate of CO2 is lower.) For this report, it was assumed that no carbon monoxide or smoke was being produced due to incomplete combustion in the burners (which would result in low fuel efficiencies). Part load conditions were ignored for the burners. Only operation at high-fire was considered.

So, typically, **natural gas produces 0.40 kg/kWh or 0.882 lbm/kWh of CO2** and **#2 oil produces 0.27kg/kWh or 0.595 lbm/kWh of CO2.**

An estimate of the emissions from MCCCH's Weishaupt burners/BROAD absorption chillers is summarized in the table below.

				Total Estimated Emissions (lbm/yr) if…		
Fuel Type	**Emission**	**lbm/kWh**		**Absorption chillers use 5% of the building's yearly total kWh estimated prior in his report**	**Absorption chillers use 10% of the building's yearly total kWh estimated prior in his report**	**Absorption chillers use 15% of the building's yearly total kWh estimated prior in his report**
Natural Gas Fired:	Particulates	N/A		N/A	N/A	N/A
	SOx	N/A		N/A	N/A	N/A
	NOx	0.000136		23.25	46.50	69.75
	CO2	0.882		150773.71	301547.42	452321.13
Oil Fired:	Particulates	N/A		N/A	N/A	N/A
	SOx	0.00055		94.02	188.04	282.06
	NOx	0.00116		198.30	396.59	594.89
	CO2	0.595		101712.42	203424.85	305137.27

The process and numbers for the above calculations were provided by a Weishaupt Burners manufacturer representative.

Table 5: Estimated Emissions for the Weishaupt Burners on MCCCH's BROAD Absorption Chillers

Weishaupt burners are categorized as "low NOx" burners. However, no statistical information about this subject could be collected for this report. The information may be needed for redesign and will be looked into further at that point.

With future analyses on MCCCH's energy usage, it will be possible to compare the above, current building emissions to those speculated in any proposal for new building systems as long as the calculation process remains the same. Intentions are that future comparisons will demonstrate an overall reduction in number building emissions.

4.0 Building Envelope Compliance:

A building's envelope or enclosure from the exterior is designed with the intent of controlling the migration of moisture and air both into and out of a building conditioned space. Because of this, the building enclosure plays an extremely significant role in the design of building mechanical and thus, electrical systems. The envelope for a building can have very crucial affects on both a building's thermal/mechanical load and energy usage.

ASHRAE Standard 90.1-1999 deals with designing the building envelope. It outlines insulation values that should be met by all types of building enclosures in different climates/geographic location. This section of the report will show that the Montgomery County Conference Center and Hotel's exterior envelope does comply with ASHRAE's Standard 90.1-1999.

ASHRAE Standard 90.1-1999 makes it very easy to rate a building's exterior envelope. Maximum U values and minimum R values for exterior assemblies and insulation are presented in Table 5.3. These values are based on climate/geographic location. The specific climate zone for the Washington D.C. area, as defined by ASHRAE, is zone 4A.

All of the exterior walls for MCCCH are mass construction and are above grade. For nonresidential buildings in the Washington, D.C. area (zone 4A), the maximum mass wall U value from Table 5.3-4 is 0.151 and the minimum wall R-value is 5.7. For this part of the report, three different mass wall assemblies from MCCCH were compared with ASHRAE's Standard 90.1-1999. These included an east wall, a south wall, and a wall with decorative aluminum paneling on its exterior. These three wall sections were chosen to be analyzed as they are the most typical throughout the entire building. Breakdowns of each wall's composition/R-values can be seen in the calculation table below.

MCCCH's two main roof assemblies were also analyzed for this section of the report. The ASHRAE prescribed values for the roof (from table 5.3-4) were a maximum U value of 0.063 and a minimum R-value of 15. Breakdowns of each roof assembly's composition/R-values can also be seen in the calculation table below.

Wall Section	Thickness	Density	Specific Heat	R-Value
East Wall	in	lb/ft^2	BTU/lb/F	hr-ft^2-F/BTU
Inside Surface Resistance	0.00	0.00	0.00	0.69

Gypsum Board	0.63	50.00	0.26	0.56
Air Space	18.00	0.00	0.00	0.91
R-14 Board Insulation	2.00	2.00	0.22	13.89
4-in LW Concrete	4.00	40.00	0.20	3.33
Outside Surface Resistance	0.00	0.00	0.00	0.33

Standard 90.1

Rinsulation =	**13.89>10, Ok**
Rtotal =	**19.71**
Uwall =	**0.05 < 0.151, Ok**

Wall Section	**Thickness**	**Density**	**Specific Heat**	**R-Value**
South Wall	**in**	**lb/ft^2**	**BTU/lb/F**	**hr-ft^2-F/BTU**
Inside Surface Resistance	0.00	0.00	0.00	0.69
Gypsum Board	0.63	50.00	0.26	0.56
R-13 Batt Insulation	4.00	0.50	0.20	12.82
Air Space	1.00	0.00	0.00	0.91
4-in LW Concrete	4.00	40.00	0.20	3.33
Outside Surface Resistance	0.00	0.00	0.00	0.33

Standard 90.1

Rinsulation =	**12.82>10, Ok**
Rtotal =	**18.64**
Uwall =	**0.054< 0.151, Ok**

Wall Section	**Thickness**	**Density**	**Specific Heat**	**R-Value**
Aluminum Panel Wall	**in**	**lb/ft^2**	**BTU/lb/F**	**hr-ft^2-F/BTU**
Inside Surface Resistance	0.00	0.00	0.00	0.69
Gypsum Board	0.63	50.00	0.26	0.56
Air Space	1.00	0.00	0.00	0.91
R-14 Board Insulation	2.00	2.00	0.22	13.89
Metal Panel	0.03	489.00	0.12	0.00
Outside Surface Resistance	0.00	0.00	0.00	0.33

Standard 90.1

Rinsulation =	**13.89>10, Ok**
Rtotal =	**16.38**
Uwall =	**0.061< 0.151, Ok**

Roof Section	**Thickness**	**Density**	**Specific Heat**	**R-Value**
C.C. Roof, Typ.	**in**	**lb/ft^2**	**BTU/lb/F**	**hr-ft^2-F/BTU**
Inside Surface Resistance	0.00	0.00	0.00	0.69
4-in LW Concrete Block Paver	4.00	40.00	0.20	3.33
R-14 Board Insulation	2.50	2.00	0.22	17.36

4-in HW Concrete	5.00	140.00	0.20	0.42
Outside Surface Resistance	0.00	0.00	0.00	0.33

Standard 90.1	**Rinsulation =**	**17.36>15, Ok**
	Rtotal =	**22.13**
	Uwall =	**0.045< 0.063, Ok**

Roof Section	**Thickness**	**Density**	**Specific Heat**	**R-Value**
Hotel Roof, Typ.	**in**	**lb/ft^2**	**BTU/lb/F**	**hr-ft^2-F/BTU**
Inside Surface Resistance	0.00	0.00	0.00	0.69
Aggregate Ballast	0.50	270.00	0.30	0.05
R-14 Board Insulation	3.00	2.00	0.22	20.83
4-in HW Concrete	5.00	140.00	0.20	0.42
Outside Surface Resistance	0.00	0.00	0.00	0.33

Standard 90.1	**Rinsulation =**	**20.83>15, Ok**
	Rtotal =	**22.32**
	Uwall =	**0.045< 0.063, Ok**

The process and numbers for the above calculations were provided by Carrier's Hourly Analysis Program.

Table 6: MCCCH's Wall and Roof Assemblies / Building Envelope Compliance

For fenestrations, the U-value and solar heat gain coefficients (SHGC) are a function of a building's exterior percentage of vertical glazing. It was approximated that MCCCH's exterior was between 30 and 40 percent glass and therefore, the max U-value for fixed fenestrations was 0.57. The U-value for operable fenestrations was 0.67, however, MCCCH does not really contain any operable fenestrations. The SHGCs for MCCCH were determined to be 0.39 for all orientations and 0.49 for the north orientation. Most of the glass used for the building was fixed and described as clear, tempered, 1" insulating glass on the design documents. By using the ASHRAE Handbook of Fundamentals 2001, Chapter 30 on fenestrations, Table 4, it was determined that the average U-value for all of MCCCH's fenestrations is 0.53, which is less than the 0.57 required. MCCCH's fenestrations comply with ASHRAE Standard 90.1-1999.

So, once again, a building's envelope is critical to the design of building mechanical and electrical systems because the building enclosure is a key factor in how much energy a building uses. For example, the worse a building enclosure assembly/insulation, the higher the thermal load is on the building; and in order for the building's mechanical system, operated by the electrical system, to offset this greater load, more energy must be used, creating more emissions and a greater cost for the building owner. Everything is connected to the building

envelope if you look at it in this way. Therefore, if there was some type of increase in a building's exterior insulation, the % change in the building's skin load could be calculated as some kind of savings. Greater building first costs would be experienced due to better initial building materials but, yearly energy costs would decrease.

5.0 Building Lighting Compliance:

Lighting is yet another factor to consider when analyzing building energy usage. It has an affect on both a building's electricity consumption as well as thermal load. When designing a building, it is very important that a lighting designer pay much attention to the energy usage of his or her design. He or she wants to make sure that the design provides enough light for the building occupants while not using too much electricity or producing an excessive amount of thermal load. However, where does a lighting designer draw the line? ASHRAE Standard 90.1-1999 provides a most efficient method for lighting design / lighting power density.

In using ASHRAE Standard 90.1-1999, power allowance for lighting can be determined by two different methods. The first method is called the "Building Area Method". This procedure requires that a building's total wattage from lighting be added up and divided by the building's total area. The result is then compared to a standard value published by ASHRAE according to that particular building's typical usage. For compliance with the ASHRAE Standard, the calculated value must be less than the standard. The second method for determining lighting power density is called the "Space-by-Space Method". This procedure provides standard lighting power density values based on spatial activities. The overall lighting power allowance for the entire building is determined by the sum of all of the individual space allowances. Therefore, lighting power tradeoffs can be made between spaces throughout the building. If one space uses more than allotted but another does not, the two will balance, causing the overall lighting power allowance to remain the same.

For this analysis of MCCCH's lighting power density compliance with ASHRAE Standard 90.1, the "Space-by-Space Method" will be used. Several, very typical/relevant rooms from both the conference center and hotel were chosen as examples for this calculation. The typical spaces are listed in the detailed calculation table below.

Overall, MCCCH's building spaces were over ASHRAE's suggested lighting power densities. The lighting system for the conference center and hotel seems to be very intense with a lot of incandescent custom fixtures. Incandescent fixtures tend to require higher wattages than fluorescent fixtures. This could be one cause of the building's incompliance with ASHRAE Standard 90.1-1999.

Typical Space	Area (sq. ft.)	Fixture Type	Quantity	Watts / Fixture	Total Watts	Watts/sq. ft.	Allowable Watts/sq. ft.	Compliant?
Electrical/Mechanical	612.00	Fluorescent Surface Pendant	8.00	64.00	512.00	0.84	1.30	Yes
Stairs - Active	320.00	6" Aperture Incand. Downlight	3.00	100.00	300.00			
		Incand. Pendant	2.00	240.00	480.00			
					780.00	2.44	0.90	No
Corridor/Transition	400.00	Wall Sconce	6.00	150.00	900.00			
		Recessed	8.00	18.00	144.00			
		Ceiling Mounted	2.00	26.00	52.00			
					1096.00	2.74	0.70	No
Restrooms	768.00	Recessed	12.00	18.00	216.00			
		Recessed	22.00	32.00	704.00			
					920.00	1.20	1.00	No
Food Preparation	640.00	Recessed	9.00	96.00	864.00	1.35	2.20	Yes
Dining Area	416.00	Recessed	6.00	100.00	600.00			
		Ceiling Mounted	1.00	240.00	240.00			
					840.00	2.02	1.40	No
Lounge/Recreation	416.00	Recessed	6.00	100.00	600.00			
		Ceiling Mounted	1.00	240.00	240.00			
					840.00	2.02	1.40	No
Lobby	520.00	Surface/Cove	16.00	25.00	400.00			
		Recessed	4.00	100.00	400.00			
		Pendant	1.00	240.00	240.00			
					1040.00	2.00	1.80	No
Audience/Seating Area	1280.00	Recessed	32.00	100.00	3200.00	2.50	0.50	No
Classrooms/Lecture	850.00	Surface/Cove	12.00	25.00	300.00			
		Recessed	8.00	100.00	800.00			
		Pendant	1.00	240.00	240.00			
					1340.00	1.58	1.60	Yes
Multipurpose	1000.00	Recessed	12.00	250.00	3000.00	3.00	1.50	No
Office - enclosed	140.00	Recessed	2.00	96.00	192.00	1.37	1.50	Yes

Data taken from design drawings and ASHRAE Standard 90.1-1999, Table 9.3.1.2.

Table 7: MCCCH's Lighting Power Density Compliance

6.0 Lost Rentable Space due to Mechanical System:

"Rentable space" is the overall purpose for most commercial buildings. It is one of the most valuable aspects of a building. Therefore, it is important to consider the percentage of a building's total area that may be lost to things like mechanical equipment during the design process.

For this section of the report, the areas of all mechanical rooms as well as mechanical shafts were taken off of MCCCH's architectural drawings. They were then compared to the total building square footage. The total lost rentable space was determined to be approximately 9,809 sq. ft. 1,380 sq. ft. of this total was due to the mechanical shafts while 8,429 sq. ft. was due to the building's mechanical rooms. This total loss in rentable space accounts for about 4.1% of MCCCH's total floor area, (see table below for breakdown).

Space	Area (sq. ft.)	Components
C.C. Lower Level Mechanical Room	1,785.00	Absorption Chillers, Water Storage, and Pumps
C.C. Lower and Upper Level Mezzanine Mechanical Rooms	6,644.00	AHU's 1-9 serving the C.C., kitchen, and hotel main areas. OA louvers here as well.
	8,429.00	
Note: No designated shaft space (sq. ft.) exists in the Conference Center and Main Hotel areas		
Hotel Shaft 1 (over 10 floors)	240.00	Separate Toilet Exhaust Shafts
Hotel Shaft 2 (over 10 floors)	320.00	Corridor Supply from two rooftop AHU's
Hotel Shaft 3 (over 10 floors)	320.00	Smoke Exhaust
Hotel Shaft 4 (over 10 floors)	500.00	Stair Pressurization
	1,380.00	
Total Lost Square Footage:	**9,809.00**	
Building Square Footage:	**240,000.00**	
Percentage:	**4.09**	**%**

Table 8: Lost Rentable Space due to Mechanical System

7.0 Mechanical System First Cost:

In the early stages of a building's design, analyses regarding different costs must be performed. Owners and architects most often choose to look at a building's first cost information as well its life-cycle costs. Both of these cost types can be broken down into building system costs. Most of the time, building system, first costs have a greater influence over the decisions made throughout the design of a building project. This is due to a trend that buildings or building systems with lower first costs end up with higher operating costs. The higher the operating cost of a building, the higher that building's or building system's overall life-cycle cost. The flipside to this issue is that, normally, higher first costs are balanced by lower operating costs over the life of a building. This payback overtime can even sometimes be higher than the initial, extra expense in first cost. Ultimately, the building owner or the "money" behind any building project determines what cost factor is more important, first cost or life-cycle cost.

For this building project report, a mechanical system, first cost breakdown was compiled. The first costs were determined with the help of the mechanical contractor on the project. Some general estimates were made but, overall, the

mechanical system costs for the Montgomery County Conference Center and Hotel (shown below) are all based on real building and construction data. The total mechanical system first cost was $4,461,000. This amount represents approximately 10% of the MCCCH's total cost.

Mechanical System First Cost:		
Sheet Metal	$1,325,000	
Labor	$735,000	
Material	$271,000	
Shop	$319,000	
Pipe Fitting	$896,000	
Labor	$559,000	
Material	$280,000	
Shop	$57,000	
General Conditions	$377,333	
Start/Test	$45,000	
Equipment	$1,302,000	
FCU'S	$228,000	
VAV'S	$44,000	
Absorption Chillers (2)	$227,000	
AHU'S & VFD's (11)	$237,000	
HVAC Pumps, Water Heaters, DW Storage Tanks	$111,000	
Cooling Towers (2)	$66,000	
Fans, Dampers, GRD's	$130,000	
AC Units (comp. room and splits)	$23,000	
Fuel Storage Tank & Pumps	$94,000	
Water Softener	$12,000	
Unit Heaters	$48,000	
Chiller Breeching	$25,000	
Equipment Vibration Isolation	$7,000	
Starters	$20,000	
Heat Trace	$7,000	
Miscellaneous Equipment	$23,000	
Subs	$515,667	
Insulation	$184,000	
Controls	$227,333	
Firestopping	$15,667	
Core Drill	$2,000	
Chemical Treatment	$9,333	
Detailing	$46,000	
Balance	$31,333	

Total:	**$4,461,000**	
Approximate Building First Cost:	**$45,000,000**	
Percentage:	**9.91**	**%**

Cost information for table was obtained from building mechanical contractor.

Table 9: Mechanical System First Costs

With the building size being approximately 240,000 sq. ft., this total mechanical system first cost yields a per square foot cost of $18.75/sq. ft.

8.0 Building Design Load Analysis:

This portion of technical assignment #2 deals with the calculation/estimation of the building loads that exists for the Montgomery County Conference Center and Hotel. The main focus is particularly on the cooling loads for the building. Building cooling loads can be attributed to a number of causes including internal thermal generation throughout different building spaces and heat gain due to energy transfer through a building's envelope. Examples of internal thermal generation that apply to the Montgomery County Conference Center and Hotel include people, lighting, technical (electrical) equipment, building electrical and mechanical equipment, and kitchen equipment. An example of energy transfer through the building's envelope could be solar gain. Solar gain is experienced by all buildings everywhere almost everyday while most internal generation load factors only apply to buildings during hours of operation. For MCCCH, the hotel and conference center portions differ in their hours of operation. It is extremely likely that the hotel half of the building runs twenty-four hours per day, seven days a week, while the conference center sees a normal "5-day work week" schedule (with the possibility of some small events) with very busy weekends (Fridays, Saturdays, and Sundays). Therefore, MCCCH's overall building load has the possibility of varying a lot from time to time.

For this analysis, the load types and daily schedules for MCCCH (mentioned above) were used along with the building's design documents/specifications and Carrier's Hourly Analysis Program (HAP) in order to estimate the building's total cooling load. Carrier's HAP was chosen because its output is more detailed and has greater accuracy than any simple load calculation process. HAP takes into account transient heat transfer due to wall orientation and building thermal mass, ceiling height, and relative space location. By using this program, MCCCH's many spaces and nine main air handling units were analyzed. The vertical fan coils units found throughout the individual hotel guestrooms were also evaluated. The two make-up air units provided for the building's kitchen area were not studied due to the fact that their main purpose is not for cooling. However, if more specific estimates are needed for redesign in the future, every piece of mechanical equipment in the building will be analyzed.

The design data/parameters used throughout the HAP load calculation process included the weather information available for Washington, D.C. The cooling

design dry-bulb and wet-bulb temperatures for this area were 95(F) and 76(F). The lights and equipment heat generation for building spaces was determined using MCCCH's design documents along with the ASHRAE Handbook of Fundamentals, 2001. The average space cooling zone parameter for thermal comfort was picked to be at 75(F) DB and 50% relative humidity.

Summaries of the HAP load calculation output for each major piece of MCCCH's mechanical equipment studied can be found in the tables below. (FCU output can be viewed in Appendix A as it was found that FCU's are not very critical in determining a building's cooling load.) In a lot of cases, the HAP load calculation output came very close to the actual design data. However, no HAP output went over the design values. This makes sense when considering the fact that a lot of mechanical designs incorporate factors of safety.

AHU-1 (VAV, serves the conference center)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	2645.6	38813	38906	258.9	0.68	0.68
Design Data	2660	50000	50000	257.4	0.88	0.88

AHU-2 (VAV, serves the conference center)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	2477.4	32965	32296	240.5	0.66	0.65
Design Data	2660	50000	50000	224	1	1

AHU-3 (VAV, serves the C.C. and hotel restaurant)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	501.8	8654	5535	221.9	0.93	0.6
Design Data	609	12500	12500	182.8	1.35	1.35

AHU-4 (CV, serves the C.C. and hotel kitchen)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	162.6	5030	1250	645.9	0.57	0.14
Design Data	360	9000	9000	291.7	1.03	1.03

AHU-5 (VAV, serves the main hotel areas)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	301.9	9072	9072	493.9	0.73	0.1
Design Data	360	9000	9000	414.1	0.72	0.72

AHU-6 (CV, serves the hotel exercise room)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	41.1	1206	240	598.9	0.59	0.12
Design Data	60	1400	1400	409.9	0.68	0.68

AHU-7 (CV, serves the hotel pool)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	94.2	2966	500	244.5	1.54	0.26
Design Data	157	3200	3200	146.7	1.67	1.67

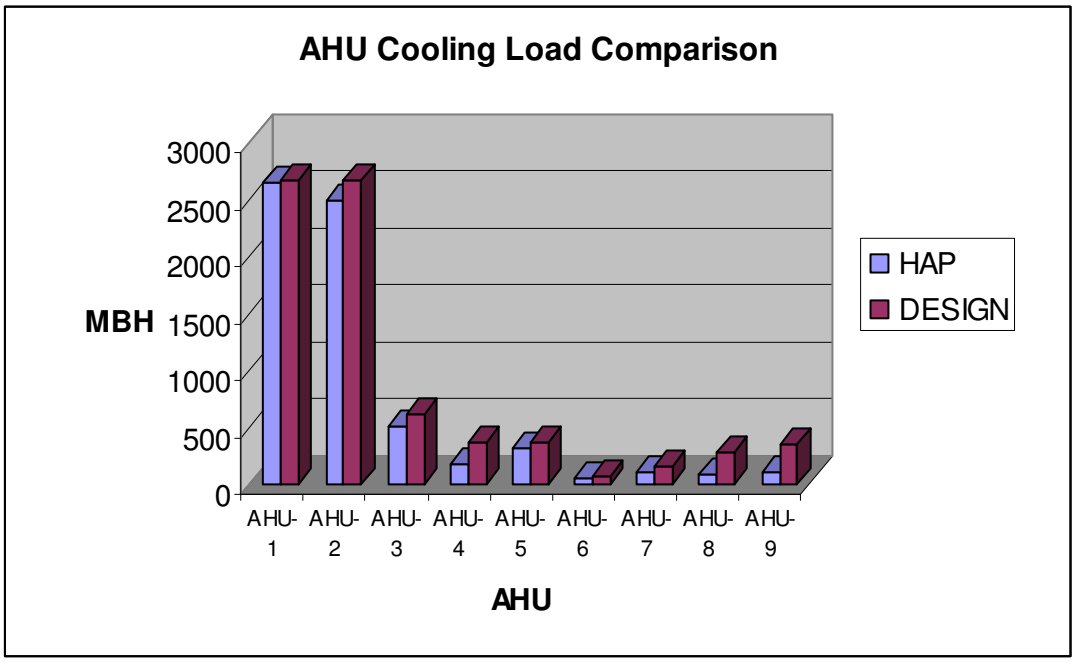
AHU-8 (CV, serves the hotel guest corridors)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	74.9	3304	433	1362.7	0.39	0.05
Design Data	270	4000	4000	377.7	0.47	0.47

AHU-9 (CV, serves the hotel guest corridors)						
	Capacity (MBH)	Supply (cfm)	Ventilation (cfm)	Cooling (ft^2/ton)	Supply/ft^2 (cfm/ft^2)	Ventilation (cfm/ft^2)
HAP Output	96.2	4460	506	1247.9	0.45	0.05
Design Data	338	5000	5000	355	0.5	0.5

Table 10: HAP Building Load Analysis Results

From the table above, the HAP calculation output proves to be pretty accurate or close with the actual design data. Like stated before, most of the design loads are higher than the HAP values. This could be due to certain safety factors utilized by the design engineers. In the few places that the two sets of data were a little different, the inconsistency could have been caused by many things, such as, estimated occupancy loads, special equipment loads, and lighting system information.

Below is a graphical summary of all air handling units evaluated. Further HAP output can be found in Appendix A.



Graphic 1: HAP Building Load Analysis Results

9.0 Building Energy Consumption and Operating Cost Due to Mechanical System:

This section of technical assignment #2 focuses on performing a building energy and operating cost analysis for the Montgomery County Conference Center and Hotel's building mechanical system. To perform this task, Carrier's Hourly Analysis Program (HAP) was implemented yet again. By using the HAP building load estimations and system simulations done in Section 8 of this report, it was very simple to run a full building simulation in order to obtain building energy and operating cost information. The same weather data that was applied in Section 8 of this report for the Washington D.C. area was also used here. Electricity and fossil fuel cost estimates were obtained for the MCCCH building project and entered into HAP. The electricity cost used was a simple cost while the natural gas rate structure was a little more complex. The exact rates utilized for the HAP calculation are listed below.

```
ELECTRIC

  Pepco: $1920.72/14,560 kwh

GAS

  Washington Gas Distribution Charge
    up to 300 TH @ $.3122
    from 300 to 6700 TH @ $.2166
    over 6700 TH @ $.1538
  Gas Supply Service
    $.888/TH
  Montgomery County, MD
    $.116/TH
```

The assumed operation schedule for the building was broken up between the conference center and hotel. The hotel's operation was assumed to be a twenty-four hour, seven days a week type of schedule all the time. The conference center, during the week (Mon.-Thurs.), followed an 8 A.M. to 8 P.M. kind of schedule. On the weekends, its operation hours increased to include about a 7-8 A.M. to 10 P.M. schedule.

Supply airflow to all building zones was based on a minimum airflow rate of 20 cfm/person and the ventilation rates were set to meet ASHRAE Standard 62. All of the AHU's were either constant or variable volume systems following most of the general HAP default settings.

Other equipment entered into the HAP program included the two absorption chillers/heaters and two cooling towers. The chillers were entered as direct-fired absorption chillers, each with a cooling capacity of 300 tons and equal unloading. The heating capacity of each chiller was 5000 MBH with an input of 5900 MBH

of natural gas. This yields an effective boiler efficiency of 85%. The chilled water flow rate for each chiller was entered at 719 gpm. The condenser water flow rate was 1300 gpm. The distribution from the chillers was primary/ secondary with variable speed drives. The two cooling towers each had a flow rate of 1300 gpm along with a 10 degree temperature range and 7 degree approach. The fan type for the cooling towers was axial.

All of the information and more was entered into Carrier's Hourly Analysis Program and the following building energy usage was obtained.

1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	**28,909**	**0.166**	**6.8**
Cooling (chiller)	**33,518**	**0.192**	**7.9**
Heating	6,234	0.036	1.5
Pumps	0	0.000	0.0
Cooling Tower Fans	**58,451**	**0.335**	**13.8**
HVAC Sub-Total	**127,112**	**0.728**	**30.0**
Lights	**256,523**	**1.469**	**60.5**
Electric Equipment	**31,208**	**0.179**	**7.4**
Misc. Electric	**0**	**0.000**	**0.0**
Misc. Fuel Use	9,309	0.053	2.2
Non-HVAC Sub-Total	**297,040**	**1.701**	**70.0**
Grand Total	**424,151**	**2.429**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

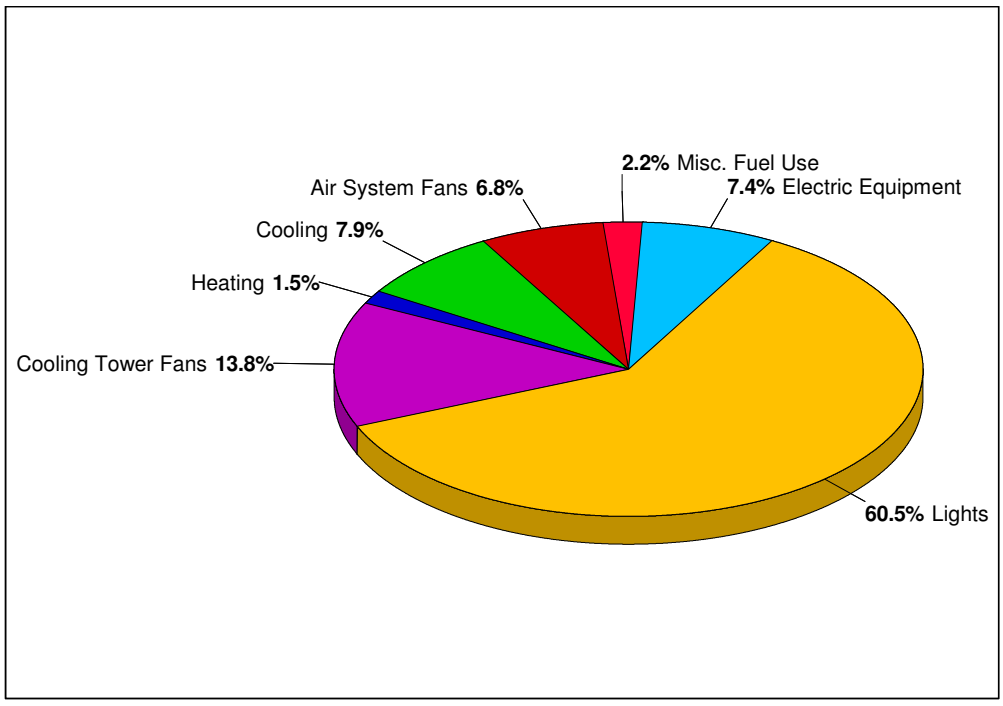


Table 11 and Graphic 2: HAP Energy Analysis Results

No energy analysis done by MCCCH's design engineer could be obtained for this project. The original MCCCH building mechanical design did have an energy analysis performed on it (using TraneTrace) however, after the analysis, the building's mechanical design was completely revamped and no new analysis was calculated. Therefore, no useful analysis exists for the building's current mechanical design and nothing can be used as a comparison to calculations done in this report. Also, no energy utilization data from meter data or utility bills was obtained for this assignment as MCCCH is still under construction. The HAP energy usage cannot be compared to the actual building performance.

10.0 References:

1. Leadership in Energy and Environmental Design's (LEED's) Green Building Rating System for New Construction and Major Renovations.
2. "Electricity Consumption and Expenditure Intensities" data of 1999.
3. Electric Power Annual 1999, Volume II, October 2000, DOE/EIA – 0348(99)/2, Energy Information Administration, US DOE, Washington, D.C.
4. ASHRAE Standard 90.1-1999, Building Envelope and Lighting Sections.
5. ASHRAE Handbook of Fundamentals, 2001.
6. Carrier's Hourly Analysis Program (HAP)
7. The Pennsylvania State University Architectural Engineering Department, Thesis Advisors - Technical Assignment #2: Dr. James D. Freihaut and Dr. Jae-Weon Jeong.
8. Past Thesis Technical Assignments/Reports, E-thesis Archives, 2004
9. BROAD U.S.A. and Weishaupt Burners
10. RTKL Associates, Engineering Design Group, and Southland Industries, Mechanical Drawings and Specifications.

11.0 Appendix A – HAP Design Load Calculation Output

Only the most pertinent HAP output pertaining to this report is contained in this appendix.

Air System Sizing Summary for AHU-1

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
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Air System Information

Air System Name	**AHU-1**		Number of zones	**29**	
Equipment Class	**CW AHU**		Floor Area	**57069.0**	ft²
Air System Type	**VAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**220.5**	Tons	Load occurs at	**Aug 1600**	
Total coil load	**2645.6**	MBH	OA DB / WB	**94.5** / **75.9**	°F
Sensible coil load	**1541.2**	MBH	Entering DB / WB	**95.5** / **76.1**	°F
Coil CFM at Aug 1600	**34497**	CFM	Leaving DB / WB	**54.0** / **52.8**	°F
Max block CFM at Jul 1700	**38906**	CFM	Coil ADP	**49.4**	°F
Sum of peak zone CFM	**41108**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.583**		Resulting RH	**58**	%
ft²/Ton	**258.9**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**46.4**		Zone T-stat Check	**28 of 29**	OK
Water flow @ 10.0 °F rise	**529.41**	gpm	Max zone temperature deviation	**1.6**	°F

Preheat Coil Sizing Data

Max coil load	**814.4**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**21597**	CFM	Ent. DB / Lvg DB	**15.0** / **50.0**	°F
Max coil CFM	**38906**	CFM			
Water flow @ 20.0 °F drop	**81.49**	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1700	**38906**	CFM	Fan motor BHP	**18.83**	BHP
Standard CFM	**38813**	CFM	Fan motor kW	**14.04**	kW
Actual max CFM/ft²	**0.68**	CFM/ft²	Fan static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM at Jul 1700	**38906**	CFM	Fan motor BHP	**18.83**	BHP
Standard CFM	**38813**	CFM	Fan motor kW	**14.04**	kW
Actual max CFM/ft²	**0.68**	CFM/ft²	Fan static	**2.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**38906**	CFM	CFM/person	**37.99**	CFM/person
CFM/ft²	**0.68**	CFM/ft²			

Air System Design Load Summary for AHU-1

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
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	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	4305 ft²	140177	-	4305 ft²	-	-
Wall Transmission	9137 ft²	8867	-	9137 ft²	26662	-
Roof Transmission	30352 ft²	9950	-	30352 ft²	108111	-
Window Transmission	4305 ft²	41427	-	4305 ft²	134960	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	26717 ft²	0	-	26717 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	111769 W	224725	-	0	0	-
Task Lighting	4339 W	12331	-	0	0	-
Electric Equipment	14345 W	45297	-	0	0	-
People	1024	227908	405685	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	50	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**710732**	**405685**	**-**	**269734**	**0**
Zone Conditioning	-	714575	405685	-	247507	0
Plenum Wall Load	20%	3192	-	0	0	-
Plenum Roof Load	80%	39800	-	0	0	-
Plenum Lighting Load	30%	114407	-	0	0	-
Return Fan Load	34497 CFM	35622	-	21597 CFM	-12441	-
Ventilation Load	34497 CFM	562479	698700	21597 CFM	1172146	0
Supply Fan Load	34497 CFM	35622	-	21597 CFM	-12441	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	5%	35537	-	5%	13487	-
>> Total System Loads	**-**	**1541233**	**1104385**	**-**	**1408258**	**0**
Central Cooling Coil	-	1541233	1104385	-	0	0
Preheat Coil	-	0	-	-	814429	-
Terminal Reheat Coils	-	0	-	-	593829	-
>> Total Conditioning	**-**	**1541233**	**1104385**	**-**	**1408258**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-2

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-2**		Number of zones	**30**	
Equipment Class	**CW AHU**		Floor Area	**49650.0**	ft²
Air System Type	**VAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**206.4**	Tons	Load occurs at	**Jul 1500**	
Total coil load	**2477.4**	MBH	OA DB / WB	**95.0** / **76.0**	°F
Sensible coil load	**1452.9**	MBH	Entering DB / WB	**96.1** / **76.3**	°F
Coil CFM at Jul 1500	**32161**	CFM	Leaving DB / WB	**54.2** / **53.0**	°F
Max block CFM at Jul 1900	**32965**	CFM	Coil ADP	**49.5**	°F
Sum of peak zone CFM	**36415**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.586**		Resulting RH	**66**	%
ft²/Ton	**240.5**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**49.9**		Zone T-stat Check	**30 of 30**	OK
Water flow @ 10.0 °F rise	**495.74**	gpm	Max zone temperature deviation	**0.0**	°F

Preheat Coil Sizing Data

Max coil load	**1108.3**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**29390**	CFM	Ent. DB / Lvg DB	**15.0** / **50.0**	°F
Max coil CFM	**32965**	CFM			
Water flow @ 20.0 °F drop	**110.89**	gpm			

Supply Fan Sizing Data

Actual max CFM at Jul 1900	**32965**	CFM	Fan motor BHP	**15.96**	BHP
Standard CFM	**32887**	CFM	Fan motor kW	**11.90**	kW
Actual max CFM/ft²	**0.66**	CFM/ft²	Fan static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM at Jul 1900	**32965**	CFM	Fan motor BHP	**15.96**	BHP
Standard CFM	**32887**	CFM	Fan motor kW	**11.90**	kW
Actual max CFM/ft²	**0.66**	CFM/ft²	Fan static	**2.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**32296**	CFM	CFM/person	**23.15**	CFM/person
CFM/ft²	**0.65**	CFM/ft²			

Air System Design Load Summary for AHU-2

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 95.0 °F / 76.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	5326 ft²	3858	-	5326 ft²	15253	-
Roof Transmission	20400 ft²	7202	-	20400 ft²	72725	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	28650 ft²	0	-	28650 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	90581 W	181225	-	0	0	-
Task Lighting	3941 W	11042	-	0	0	-
Electric Equipment	15822 W	49677	-	0	0	-
People	1395	289175	441600	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**542180**	**441600**	**-**	**87978**	**0**
Zone Conditioning	-	564517	441600	-	77275	0
Plenum Wall Load	20%	965	-	0	0	-
Plenum Roof Load	80%	28810	-	0	0	-
Plenum Lighting Load	30%	92719	-	0	0	-
Return Fan Load	32161 CFM	38326	-	29390 CFM	-30578	-
Ventilation Load	32161 CFM	641157	582877	29390 CFM	1624629	0
Supply Fan Load	32161 CFM	38326	-	29390 CFM	-30578	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	5%	27109	-	5%	4399	-
>> Total System Loads	**-**	**1431928**	**1024477**	**-**	**1645147**	**0**
Central Cooling Coil	-	1452905	1024477	-	0	0
Preheat Coil	-	0	-	-	1108290	-
Terminal Reheat Coils	-	-20977	-	-	536856	-
>> Total Conditioning	**-**	**1431928**	**1024477**	**-**	**1645146**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-3

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-3**		Number of zones	**3**	
Equipment Class	**CW AHU**		Floor Area	**9280.0**	ft²
Air System Type	**VAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**41.8**	Tons	Load occurs at	**Aug 1500**	
Total coil load	**501.8**	MBH	OA DB / WB	**95.0** / **76.0**	°F
Sensible coil load	**310.1**	MBH	Entering DB / WB	**92.0** / **73.5**	°F
Coil CFM at Aug 1500	**7548**	CFM	Leaving DB / WB	**53.9** / **52.6**	°F
Max block CFM at Sep 1400	**8654**	CFM	Coil ADP	**49.6**	°F
Sum of peak zone CFM	**9321**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.618**		Resulting RH	**49**	%
ft²/Ton	**221.9**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**54.1**		Zone T-stat Check	**3 of 3**	OK
Water flow @ 10.0 °F rise	**100.41**	gpm	Max zone temperature deviation	**0.0**	°F

Supply Fan Sizing Data

Actual max CFM at Sep 1400	**8654**	CFM	Fan motor BHP	**4.19**	BHP
Standard CFM	**8634**	CFM	Fan motor kW	**3.12**	kW
Actual max CFM/ft²	**0.93**	CFM/ft²	Fan static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM at Sep 1400	**8654**	CFM	Fan motor BHP	**4.19**	BHP
Standard CFM	**8634**	CFM	Fan motor kW	**3.12**	kW
Actual max CFM/ft²	**0.93**	CFM/ft²	Fan static	**2.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**5535**	CFM	CFM/person	**23.06**	CFM/person
CFM/ft²	**0.60**	CFM/ft²			

Air System Design Load Summary for AHU-3

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 95.0 ℉ / 76.0 ℉			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 ℉ / 12.2 ℉		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1500 ft²	38472	-	1500 ft²	-	-
Wall Transmission	568 ft²	263	-	568 ft²	1641	-
Roof Transmission	10880 ft²	3242	-	10880 ft²	38575	-
Window Transmission	1500 ft²	14557	-	1500 ft²	47025	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	800 ft²	0	-	800 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	17443 W	41148	-	0	0	-
Task Lighting	1696 W	5787	-	0	0	-
Electric Equipment	3280 W	11191	-	0	0	-
People	240	58001	46225	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	100	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**172761**	**46225**	**-**	**87240**	**0**
Zone Conditioning	-	167275	46225	-	19076	0
Plenum Wall Load	20%	483	-	0	0	-
Plenum Roof Load	80%	12969	-	0	0	-
Plenum Lighting Load	30%	17855	-	0	0	-
Return Fan Load	7548 CFM	7614	-	5053 CFM	-3043	-
Ventilation Load	5535 CFM	87658	145432	5053 CFM	147462	0
Supply Fan Load	7548 CFM	7614	-	5053 CFM	-3043	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	5%	8638	-	5%	4362	-
>> Total System Loads	**-**	**310106**	**191657**	**-**	**164815**	**0**
Central Cooling Coil	-	310106	191657	-	0	0
Terminal Reheat Coils	-	0	-	-	164815	-
>> Total Conditioning	**-**	**310106**	**191657**	**-**	**164815**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-4

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-4**	Number of zones	**1**
Equipment Class	**CW AHU**	Floor Area	**8752.0** ft²
Air System Type	**SZCAV**	Location	**Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**	Calculation Months	**Jan to Dec**
Space CFM	**Individual peak space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**13.5**	Tons	Load occurs at	**Jul 1500**	
Total coil load	**162.6**	MBH	OA DB / WB	**95.0** / **76.0**	°F
Sensible coil load	**113.3**	MBH	Entering DB / WB	**81.7** / **69.6**	°F
Coil CFM at Jul 1500	**5030**	CFM	Leaving DB / WB	**60.8** / **59.7**	°F
Max block CFM	**5030**	CFM	Coil ADP	**58.5**	°F
Sum of peak zone CFM	**5030**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.697**		Resulting RH	**60**	%
ft²/Ton	**645.9**		Design supply temp.	**58.0**	°F
BTU/(hr-ft²)	**18.6**		Zone T-stat Check	**1 of 1**	OK
Water flow @ 10.0 °F rise	**32.54**	gpm	Max zone temperature deviation	**0.0**	°F

Central Heating Coil Sizing Data

Max coil load	**102.0**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**5030**	CFM	BTU/(hr-ft²)	**11.7**	
Max coil CFM	**5030**	CFM	Ent. DB / Lvg DB	**55.9** / **74.7**	°F
Water flow @ 20.0 °F drop	**10.21**	gpm			

Supply Fan Sizing Data

Actual max CFM	**5030**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**5018**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**0.57**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**1250**	CFM	CFM/person	**17.86**	CFM/person
CFM/ft²	**0.14**	CFM/ft²			

Air System Design Load Summary for AHU-4

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
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	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 95.0 °F / 76.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	8752 ft²	14075	-	8752 ft²	31033	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	11343 W	38700	-	0	0	-
Task Lighting	1434 W	4891	-	0	0	-
Electric Equipment	3584 W	12229	-	0	0	-
People	70	20650	31850	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	80	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**90624**	**31850**	**-**	**31033**	**0**
Zone Conditioning	-	89383	31850	-	28758	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	5030 CFM	0	-	5030 CFM	0	-
Ventilation Load	1250 CFM	23873	17487	1250 CFM	73272	0
Supply Fan Load	5030 CFM	0	-	5030 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**113256**	**49337**	**-**	**102030**	**0**
Central Cooling Coil	-	113256	49339	-	0	0
Central Heating Coil	-	0	-	-	102030	-
>> Total Conditioning	**-**	**113256**	**49339**	**-**	**102030**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-5

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-5**		Number of zones	**5**	
Equipment Class	**CW AHU**		Floor Area	**12426.0**	ft²
Air System Type	**VAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**25.2**	Tons	Load occurs at	**Jul 1600**	
Total coil load	**301.9**	MBH	OA DB / WB	**94.5** / **75.9**	°F
Sensible coil load	**256.6**	MBH	Entering DB / WB	**84.4** / **65.6**	°F
Coil CFM at Jul 1600	**7781**	CFM	Leaving DB / WB	**53.8** / **52.2**	°F
Max block CFM at Aug 1600	**9072**	CFM	Coil ADP	**50.4**	°F
Sum of peak zone CFM	**9927**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.850**		Resulting RH	**41**	%
ft²/Ton	**493.9**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**24.3**		Zone T-stat Check	**5 of 5**	OK
Water flow @ 10.0 °F rise	**60.42**	gpm	Max zone temperature deviation	**0.0**	°F

Supply Fan Sizing Data

Actual max CFM at Aug 1600	**9072**	CFM	Fan motor BHP	**4.39**	BHP
Standard CFM	**9051**	CFM	Fan motor kW	**3.27**	kW
Actual max CFM/ft²	**0.73**	CFM/ft²	Fan static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM at Aug 1600	**9072**	CFM	Fan motor BHP	**4.39**	BHP
Standard CFM	**9051**	CFM	Fan motor kW	**3.27**	kW
Actual max CFM/ft²	**0.73**	CFM/ft²	Fan static	**2.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**1181**	CFM	CFM/person	**35.78**	CFM/person
CFM/ft²	**0.10**	CFM/ft²			

Air System Design Load Summary for AHU-5

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 94.5 ℉ / 75.9 ℉			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 ℉ / 12.2 ℉		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	2700 ft²	83064	-	2700 ft²	-	-
Wall Transmission	2376 ft²	1578	-	2376 ft²	7054	-
Roof Transmission	11226 ft²	4170	-	11226 ft²	28641	-
Window Transmission	2700 ft²	25982	-	2700 ft²	84644	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	1200 ft²	0	-	1200 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	19997 W	47503	-	0	0	-
Task Lighting	1564 W	5111	-	0	0	-
Electric Equipment	2925 W	9980	-	0	0	-
People	33	8085	6765	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**185471**	**6765**	**-**	**120339**	**0**
Zone Conditioning	-	177078	6765	-	99331	0
Plenum Wall Load	20%	1362	-	0	0	-
Plenum Roof Load	80%	16678	-	0	0	-
Plenum Lighting Load	30%	20469	-	0	0	-
Return Fan Load	7781 CFM	7658	-	730 CFM	-739	-
Ventilation Load	1181 CFM	16452	38530	730 CFM	31335	0
Supply Fan Load	7781 CFM	7658	-	730 CFM	-739	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	5%	9274	-	5%	6017	-
>> Total System Loads	**-**	**256630**	**45295**	**-**	**135205**	**0**
Central Cooling Coil	-	256630	45298	-	0	0
Terminal Reheat Coils	-	0	-	-	130309	-
>> Total Conditioning	**-**	**256630**	**45298**	**-**	**130309**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-6

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-6**	Number of zones	**1**
Equipment Class	**CW AHU**	Floor Area	**2050.0** ft²
Air System Type	**SZCAV**	Location	**Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**	Calculation Months	**Jan to Dec**
Space CFM	**Individual peak space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**3.4**	Tons	Load occurs at	**Jul 1700**	
Total coil load	**41.1**	MBH	OA DB / WB	**93.3** / **75.6**	°F
Sensible coil load	**25.8**	MBH	Entering DB / WB	**80.5** / **70.1**	°F
Coil CFM at Jul 1700	**1206**	CFM	Leaving DB / WB	**60.7** / **59.8**	°F
Max block CFM	**1206**	CFM	Coil ADP	**58.5**	°F
Sum of peak zone CFM	**1206**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.628**		Resulting RH	**65**	%
ft²/Ton	**598.9**		Design supply temp.	**58.0**	°F
BTU/(hr-ft²)	**20.0**		Zone T-stat Check	**1 of 1**	OK
Water flow @ 10.0 °F rise	**8.22**	gpm	Max zone temperature deviation	**0.0**	°F

Central Heating Coil Sizing Data

Max coil load	**22.0**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**1206**	CFM	BTU/(hr-ft²)	**10.7**	
Max coil CFM	**1206**	CFM	Ent. DB / Lvg DB	**58.8** / **75.7**	°F
Water flow @ 20.0 °F drop	**2.20**	gpm			

Supply Fan Sizing Data

Actual max CFM	**1206**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**1204**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**0.59**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**240**	CFM	CFM/person	**20.00**	CFM/person
CFM/ft²	**0.12**	CFM/ft²			

Air System Design Load Summary for AHU-6

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 93.3 ℉ / 75.6 ℉			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 ℉ / 12.2 ℉		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	360 ft²	399	-	360 ft²	1005	-
Roof Transmission	2050 ft²	3684	-	2050 ft²	6425	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	2380 W	8122	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	385 W	1314	-	0	0	-
People	12	8520	13080	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**22038**	**13080**	**-**	**7430**	**0**
Zone Conditioning	-	21658	13080	-	7844	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	1206 CFM	0	-	1206 CFM	0	-
Ventilation Load	240 CFM	4139	2196	240 CFM	14142	0
Supply Fan Load	1206 CFM	0	-	1206 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**25797**	**15276**	**-**	**21986**	**0**
Central Cooling Coil	-	25797	15281	-	0	0
Central Heating Coil	-	0	-	-	21986	-
>> Total Conditioning	**-**	**25797**	**15281**	**-**	**21986**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-7

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-7**		Number of zones	**1**	
Equipment Class	**PKG VERT**		Floor Area	**1920.0**	ft²
Air System Type	**SZCAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**7.9**	Tons	Load occurs at	**Aug 1600**	
Total coil load	**94.2**	MBH	OA DB / WB	**94.5** / **75.9**	°F
Sensible coil load	**61.7**	MBH	Entering DB / WB	**80.2** / **69.6**	°F
Coil CFM at Aug 1600	**2966**	CFM	Leaving DB / WB	**60.9** / **59.9**	°F
Max block CFM	**2966**	CFM	Coil ADP	**58.7**	°F
Sum of peak zone CFM	**2966**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.655**		Resulting RH	**64**	%
ft²/Ton	**244.5**		Design supply temp.	**58.0**	°F
BTU/(hr-ft²)	**49.1**		Zone T-stat Check	**1 of 1**	OK
Water flow @ 10.0 °F rise	**N/A**		Max zone temperature deviation	**0.0**	°F

Central Heating Coil Sizing Data

Max coil load	**56.1**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**2966**	CFM	BTU/(hr-ft²)	**29.2**	
Max coil CFM	**2966**	CFM	Ent. DB / Lvg DB	**60.3** / **77.9**	°F
Water flow @ 20.0 °F drop	**N/A**				

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM	**2966**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**2959**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**1.54**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**500**	CFM	CFM/person	**20.00**	CFM/person
CFM/ft²	**0.26**	CFM/ft²			

Air System Design Load Summary for AHU-7

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 94.5 ℉ / 75.9 ℉			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 ℉ / 12.2 ℉		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	600 ft²	16376	-	600 ft²	-	-
Wall Transmission	1260 ft²	1340	-	1260 ft²	3689	-
Roof Transmission	1920 ft²	3280	-	1920 ft²	4749	-
Window Transmission	600 ft²	5774	-	600 ft²	18810	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	2488 W	8490	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	384 W	1310	-	0	0	-
People	25	17750	27250	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**54320**	**27250**	**-**	**27248**	**0**
Zone Conditioning	-	52424	27250	-	26768	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	2966 CFM	0	-	2966 CFM	0	-
Ventilation Load	500 CFM	9278	5256	500 CFM	29380	0
Supply Fan Load	2966 CFM	0	-	2966 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**61702**	**32506**	**-**	**56148**	**0**
Central Cooling Coil	-	61702	32520	-	0	0
Central Heating Coil	-	0	-	-	56148	-
Preheat Coil	-	0	-	-	0	-
>> Total Conditioning	**-**	**61702**	**32520**	**-**	**56148**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-8

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

Air System Information

Air System Name	**AHU-8**		Number of zones	**1**	
Equipment Class	**PKG ROOF**		Floor Area	**8500.0**	ft²
Air System Type	**SZCAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**6.2**	Tons	Load occurs at	**Jul 1600**	
Total coil load	**74.9**	MBH	OA DB / WB	**94.5** / **75.9**	°F
Sensible coil load	**66.2**	MBH	Entering DB / WB	**79.7** / **67.1**	°F
Coil CFM at Jul 1600	**3304**	CFM	Leaving DB / WB	**61.1** / **59.9**	°F
Max block CFM	**3304**	CFM	Coil ADP	**59.0**	°F
Sum of peak zone CFM	**3304**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.884**		Resulting RH	**53**	%
ft²/Ton	**1362.7**		Design supply temp.	**58.0**	°F
BTU/(hr-ft²)	**8.8**		Zone T-stat Check	**1 of 1**	OK
Water flow @ 10.0 °F rise	**N/A**		Max zone temperature deviation	**0.0**	°F

Central Heating Coil Sizing Data

Max coil load	**36.2**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**3304**	CFM	BTU/(hr-ft²)	**4.3**	
Max coil CFM	**3304**	CFM	Ent. DB / Lvg DB	**62.7** / **72.9**	°F
Water flow @ 20.0 °F drop	**N/A**				

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM	**3304**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**3296**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**0.39**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**433**	CFM	CFM/person	**0.00**	CFM/person
CFM/ft²	**0.05**	CFM/ft²			

Air System Design Load Summary for AHU-8

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:02AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	3800 ft²	7016	-	3800 ft²	9400	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	13770 W	46982	-	0	0	-
Task Lighting	1700 W	5800	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**59799**	**0**	**-**	**9400**	**0**
Zone Conditioning	-	58215	0	-	10582	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	3304 CFM	0	-	3304 CFM	0	-
Ventilation Load	433 CFM	7950	8684	433 CFM	25621	0
Supply Fan Load	3304 CFM	0	-	3304 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**66165**	**8684**	**-**	**36203**	**0**
Central Cooling Coil	-	66165	8689	-	0	0
Central Heating Coil	-	0	-	-	36203	-
Preheat Coil	-	0	-	-	0	-
>> Total Conditioning	**-**	**66165**	**8689**	**-**	**36203**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-9

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name	**AHU-9**		Number of zones	**1**	
Equipment Class	**PKG ROOF**		Floor Area	**10000.0**	ft²
Air System Type	**SZCAV**		Location	**Washington, Dist. of Columbia**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**8.0**	Tons	Load occurs at	**Jul 1700**	
Total coil load	**96.2**	MBH	OA DB / WB	**93.3** / **75.6**	°F
Sensible coil load	**86.2**	MBH	Entering DB / WB	**79.2** / **66.9**	°F
Coil CFM at Jul 1700	**4460**	CFM	Leaving DB / WB	**61.3** / **60.1**	°F
Max block CFM	**4460**	CFM	Coil ADP	**59.3**	°F
Sum of peak zone CFM	**4460**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.896**		Resulting RH	**54**	%
ft²/Ton	**1247.9**		Design supply temp.	**58.0**	°F
BTU/(hr-ft²)	**9.6**		Zone T-stat Check	**1 of 1**	OK
Water flow @ 10.0 °F rise	**N/A**		Max zone temperature deviation	**0.0**	°F

Central Heating Coil Sizing Data

Max coil load	**60.9**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**4460**	CFM	BTU/(hr-ft²)	**6.1**	
Max coil CFM	**4460**	CFM	Ent. DB / Lvg DB	**63.3** / **76.0**	°F
Water flow @ 20.0 °F drop	**N/A**				

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM	**4460**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**4450**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**0.45**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**506**	CFM	CFM/person	**0.00**	CFM/person
CFM/ft²	**0.05**	CFM/ft²			

Air System Design Load Summary for AHU-9

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 93.3 °F / 75.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	7920 ft²	10944	-	7920 ft²	22804	-
Roof Transmission	3840 ft²	7572	-	3840 ft²	9499	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	16200 W	55273	-	0	0	-
Task Lighting	2000 W	6824	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**80613**	**0**	**-**	**32303**	**0**
Zone Conditioning	-	77507	0	-	31171	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	4460 CFM	0	-	4460 CFM	0	-
Ventilation Load	506 CFM	8694	9959	506 CFM	29719	0
Supply Fan Load	4460 CFM	0	-	4460 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**86201**	**9959**	**-**	**60890**	**0**
Central Cooling Coil	-	86201	9962	-	0	0
Central Heating Coil	-	0	-	-	60890	-
Preheat Coil	-	0	-	-	0	-
>> Total Conditioning	**-**	**86201**	**9962**	**-**	**60890**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 1

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 1**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 1

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 93.3 °F / 75.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	951	-	30 ft²	-	-
Wall Transmission	204 ft²	232	-	204 ft²	569	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	30 ft²	278	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**6179**	**240**	**-**	**1510**	**0**
Zone Conditioning	-	5808	240	-	1438	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	515	555	30 CFM	1768	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**6323**	**795**	**-**	**3206**	**0**
Terminal Unit Cooling	-	6323	809	-	0	0
Terminal Unit Heating	-	0	-	-	3206	-
>> Total Conditioning	**-**	**6323**	**809**	**-**	**3206**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 1_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 1_10**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 1_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1800 COOLING OA DB / WB 91.5 °F / 75.1 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	850	-	30 ft²	-	-
Wall Transmission	204 ft²	266	-	204 ft²	569	-
Roof Transmission	1248 ft²	2537	-	1248 ft²	3087	-
Window Transmission	30 ft²	259	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**8630**	**240**	**-**	**4597**	**0**
Zone Conditioning	-	8056	240	-	4733	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	461	562	30 CFM	1761	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**8517**	**802**	**-**	**6494**	**0**
Terminal Unit Cooling	-	8517	809	-	0	0
Terminal Unit Heating	-	0	-	-	6494	-
>> Total Conditioning	**-**	**8517**	**809**	**-**	**6494**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 2

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 2**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 2

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1700 COOLING OA DB / WB 93.3 °F / 75.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	700	-	30 ft²	-	-
Wall Transmission	636 ft²	934	-	636 ft²	1775	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	30 ft²	278	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**6630**	**240**	**-**	**2715**	**0**
Zone Conditioning	-	6345	240	-	2577	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	514	573	30 CFM	1760	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**6859**	**813**	**-**	**4337**	**0**
Terminal Unit Cooling	-	6859	818	-	0	0
Terminal Unit Heating	-	0	-	-	4337	-
>> Total Conditioning	**-**	**6859**	**818**	**-**	**4337**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 2_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 2_10**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 2_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	691	-	30 ft²	-	-
Wall Transmission	636 ft²	805	-	636 ft²	1775	-
Roof Transmission	1248 ft²	2304	-	1248 ft²	3087	-
Window Transmission	30 ft²	289	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**8806**	**240**	**-**	**5802**	**0**
Zone Conditioning	-	8229	240	-	5869	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	559	543	30 CFM	1756	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**8788**	**783**	**-**	**7625**	**0**
Terminal Unit Cooling	-	8788	788	-	0	0
Terminal Unit Heating	-	0	-	-	7625	-
>> Total Conditioning	**-**	**8788**	**788**	**-**	**7625**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 3

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 3**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 3

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 95.0 °F / 76.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	799	-	30 ft²	-	-
Wall Transmission	204 ft²	284	-	204 ft²	569	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	30 ft²	291	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**6091**	**240**	**-**	**1510**	**0**
Zone Conditioning	-	5921	240	-	1429	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	569	559	30 CFM	1768	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**6490**	**799**	**-**	**3197**	**0**
Terminal Unit Cooling	-	6490	802	-	0	0
Terminal Unit Heating	-	0	-	-	3197	-
>> Total Conditioning	**-**	**6490**	**802**	**-**	**3197**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 3_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 3_10**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 3_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 93.3 °F / 75.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	647	-	30 ft²	-	-
Wall Transmission	204 ft²	260	-	204 ft²	569	-
Roof Transmission	1248 ft²	2461	-	1248 ft²	3087	-
Window Transmission	30 ft²	278	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**8364**	**240**	**-**	**4597**	**0**
Zone Conditioning	-	7739	240	-	4787	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	516	548	30 CFM	1760	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**8256**	**788**	**-**	**6547**	**0**
Terminal Unit Cooling	-	8256	807	-	0	0
Terminal Unit Heating	-	0	-	-	6547	-
>> Total Conditioning	**-**	**8256**	**807**	**-**	**6547**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 4

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 4**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 4

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	75 ft²	1734	-	75 ft²	-	-
Wall Transmission	753 ft²	915	-	753 ft²	2101	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	75 ft²	705	-	75 ft²	2351	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**8071**	**240**	**-**	**4452**	**0**
Zone Conditioning	-	7608	240	-	4539	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	554	556	30 CFM	1760	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**8162**	**796**	**-**	**6299**	**0**
Terminal Unit Cooling	-	8162	815	-	0	0
Terminal Unit Heating	-	0	-	-	6299	-
>> Total Conditioning	**-**	**8162**	**815**	**-**	**6299**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 4_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 4_10**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 4_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 93.3 °F / 75.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	75 ft²	1488	-	75 ft²	-	-
Wall Transmission	753 ft²	922	-	753 ft²	2101	-
Roof Transmission	1248 ft²	2461	-	1248 ft²	3087	-
Window Transmission	75 ft²	695	-	75 ft²	2351	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**10284**	**240**	**-**	**7539**	**0**
Zone Conditioning	-	9681	240	-	7363	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	520	574	30 CFM	1749	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**10200**	**814**	**-**	**9112**	**0**
Terminal Unit Cooling	-	10200	835	-	0	0
Terminal Unit Heating	-	0	-	-	9112	-
>> Total Conditioning	**-**	**10200**	**835**	**-**	**9112**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 5

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 5**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 5

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	552	-	30 ft²	-	-
Wall Transmission	222 ft²	241	-	222 ft²	619	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	30 ft²	289	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**5800**	**240**	**-**	**1560**	**0**
Zone Conditioning	-	5645	240	-	1355	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	551	582	30 CFM	1765	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**6196**	**822**	**-**	**3120**	**0**
Terminal Unit Cooling	-	6196	824	-	0	0
Terminal Unit Heating	-	0	-	-	3120	-
>> Total Conditioning	**-**	**6196**	**824**	**-**	**3120**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 5_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 5_10**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 5_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	30 ft²	552	-	30 ft²	-	-
Wall Transmission	222 ft²	241	-	222 ft²	619	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	30 ft²	289	-	30 ft²	940	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**5800**	**240**	**-**	**1560**	**0**
Zone Conditioning	-	5645	240	-	1355	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	551	582	30 CFM	1765	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**6196**	**822**	**-**	**3120**	**0**
Terminal Unit Cooling	-	6196	824	-	0	0
Terminal Unit Heating	-	0	-	-	3120	-
>> Total Conditioning	**-**	**6196**	**824**	**-**	**3120**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 6

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 6**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 6

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 93.3 °F / 75.6 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	60 ft²	1468	-	60 ft²	-	-
Wall Transmission	444 ft²	498	-	444 ft²	1239	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	60 ft²	556	-	60 ft²	1881	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**7241**	**240**	**-**	**3120**	**0**
Zone Conditioning	-	6792	240	-	3092	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	515	557	30 CFM	1765	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**7307**	**797**	**-**	**4857**	**0**
Terminal Unit Cooling	-	7307	811	-	0	0
Terminal Unit Heating	-	0	-	-	4857	-
>> Total Conditioning	**-**	**7307**	**811**	**-**	**4857**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for VFC Unit 6_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

Air System Information

Air System Name ..... **VFC Unit 6_10**
Equipment Class ..... **TERM**
Air System Type **4P-FC**

Number of zones **1**
Floor Area ..... **1248.0** ft²
Location ..... **Washington, Dist. of Columbia**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Air System Design Load Summary for VFC Unit 6_10

Project Name: MCCCH
Prepared by: J.B.

10/27/2004
05:03AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 94.5 °F / 75.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 15.0 °F / 12.2 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	60 ft²	1411	-	60 ft²	-	-
Wall Transmission	444 ft²	458	-	444 ft²	1239	-
Roof Transmission	1248 ft²	2304	-	1248 ft²	3087	-
Window Transmission	60 ft²	577	-	60 ft²	1881	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1248 W	4258	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	2	460	240	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**9468**	**240**	**-**	**6207**	**0**
Zone Conditioning	-	8858	240	-	6424	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 CFM	0	-	0 CFM	0	-
Ventilation Load	30 CFM	560	548	30 CFM	1757	0
Ventilation Fan Load	0 CFM	0	-	0 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**9418**	**788**	**-**	**8181**	**0**
Terminal Unit Cooling	-	9418	796	-	0	0
Terminal Unit Heating	-	0	-	-	8181	-
>> Total Conditioning	**-**	**9418**	**796**	**-**	**8181**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Cooling Plant Sizing Summary for MCCCH_chiller

MCCCH
J.B.

10/27/2004
05:41AM

1. Plant Information:

Plant Name ..... **MCCCH_chiller**
Plant Type ..... **Chiller Plant**
Design Weather ..... **Washington, Dist. of Columbia**

2. Cooling Plant Sizing Data:

Maximum Plant Load ..... **517.5** Tons
Load occurs at ..... **Aug 1500**
ft²/Ton ..... **298.0** ft²/Ton
Floor area served by plant ..... **154203.0** ft²

3. Coincident Air System Cooling Loads for Aug 1500

Air System Name	Mult.	System Cooling Coil Load (Tons)
AHU-1	1	219.9
AHU-2	1	206.3
AHU-3	1	41.8
AHU-4	1	13.2
AHU-5	1	24.6
AHU-6	1	3.4
VFC Unit 1	1	0.6
VFC Unit 1_10	1	0.7
VFC Unit 2	1	0.6
VFC Unit 2_10	1	0.8
VFC Unit 3	1	0.6
VFC Unit 3_10	1	0.7
VFC Unit 4	1	0.7
VFC Unit 4_10	1	0.9
VFC Unit 5	1	0.6
VFC Unit 5_10	1	0.6
VFC Unit 6	1	0.6
VFC Unit 6_10	1	0.8

System loads are for coils whose cooling source is ' Chilled Water ' .

Hourly Chiller Load Profiles for MCCCH_chiller

MCCCH
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10/27/2004
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1. Plant Information:

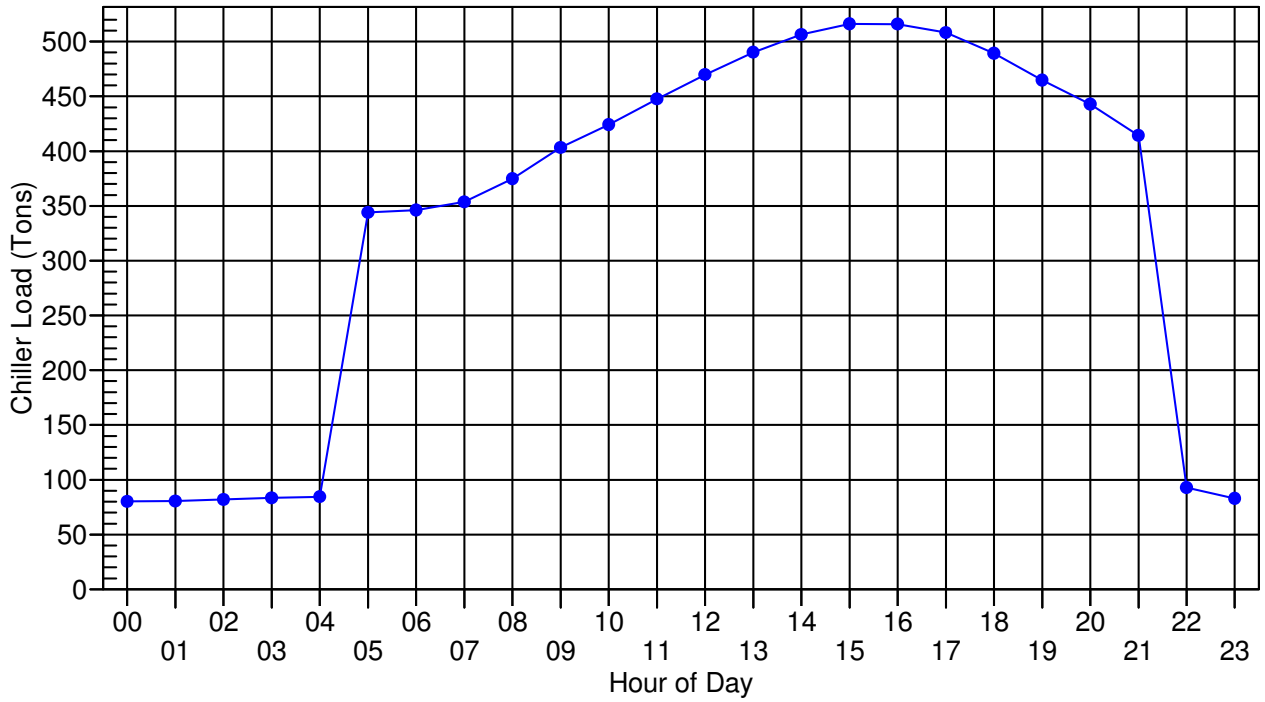
Plant Name ..... **MCCCH_chiller**
Plant Type ..... **Chiller Plant**
Design Weather ..... **Washington, Dist. of Columbia**

2. Chiller Load Profiles from July to July :

Hour	DESIGN MONTH: JULY	
	OA TEMP (℉)	TOTAL COOLING (Tons)
0000	81.4	80.1
0100	80.6	80.5
0200	79.7	81.9
0300	79.1	83.4
0400	78.6	84.5
0500	78.4	344.0
0600	78.7	346.1
0700	79.6	353.6
0800	81.1	374.8
0900	83.2	403.2
1000	85.7	424.2
1100	88.5	447.6
1200	91.2	469.8
1300	93.2	490.2
1400	94.5	506.4
1500	95.0	516.1
1600	94.5	515.9
1700	93.3	508.2
1800	91.5	489.2
1900	89.4	464.8
2000	87.2	442.8
2100	85.4	414.3
2200	83.7	92.9
2300	82.4	82.9
Total Ton-hrs		**8097.5**

Chiller Design Day Loads for MCCCH_chiller

Data for July



Unmet Load Report for MCCCH_chiller

MCCCH
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10/27/2004
05:43AM

1. Unmet Load Statistics

Month	Equipment Capacity is Sufficient (hrs)	Capacity Insufficient by 0%-5% (hrs)	Capacity Insufficient by 5%-10% (hrs)	Capacity Insufficient by >10% (hrs)	Total Hours with Unmet Loads	Total Hours with Equipment Loads
January	744	0	0	0	0	744
February	672	0	0	0	0	672
March	744	0	0	0	0	744
April	720	0	0	0	0	720
May	744	0	0	0	0	744
June	720	0	0	0	0	720
July	744	0	0	0	0	744
August	744	0	0	0	0	744
September	720	0	0	0	0	720
October	744	0	0	0	0	744
November	720	0	0	0	0	720
December	744	0	0	0	0	744
Total	**8760**	**0**	**0**	**0**	**0**	**8760**

12.0 Appendix B – HAP Energy Consumption and Operating Cost Calculation Output

Only the most pertinent HAP output pertaining to this report is contained in this appendix.

Annual Cost Summary

MCCCH
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05:48AM

Table 1. Annual Costs

Component	MCCCH ($)
Air System Fans	28,909
Cooling	33,518
Heating	6,234
Pumps	0
Cooling Tower Fans	58,451
HVAC Sub-Total	**127,112**
Lights	256,523
Electric Equipment	31,208
Misc. Electric	0
Misc. Fuel Use	9,309
Non-HVAC Sub-Total	**297,040**
Grand Total	**424,151**

Table 2. Annual Cost per Unit Floor Area

Component	MCCCH ($/ft²)
Air System Fans	0.166
Cooling	0.192
Heating	0.036
Pumps	0.000
Cooling Tower Fans	0.335
HVAC Sub-Total	**0.728**
Lights	1.469
Electric Equipment	0.179
Misc. Electric	0.000
Misc. Fuel Use	0.053
Non-HVAC Sub-Total	**1.701**
Grand Total	**2.429**
Gross Floor Area (ft²)	174623.0
Conditioned Floor Area (ft²)	174623.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 3. Component Cost as a Percentage of Total Cost

Component	MCCCH (%)
Air System Fans	6.8
Cooling	7.9
Heating	1.5
Pumps	0.0
Cooling Tower Fans	13.8
HVAC Sub-Total	**30.0**
Lights	60.5
Electric Equipment	7.4
Misc. Electric	0.0
Misc. Fuel Use	2.2
Non-HVAC Sub-Total	**70.0**
Grand Total	**100.0**

Annual Energy and Emissions Summary

MCCCH
J.B.

10/27/2004
05:48AM

Table 1. Annual Costs

Component	MCCCH ($)
HVAC Components	
Electric	97,753
Natural Gas	29,358
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**127,112**
Non-HVAC Components	
Electric	287,729
Natural Gas	9,309
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**297,038**
Grand Total	**424,150**

Table 2. Annual Energy Consumption

Component	MCCCH
HVAC Components	
Electric (kWh)	726,002
Natural Gas (TH)	156,632
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	2,136,866
Natural Gas (TH)	47,263
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	2,862,868
Natural Gas (TH)	203,895
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Table 3. Annual Emissions

Component	MCCCH
CO2 (lb)	3,950,456
SO2 (kg)	5,754
NOx (kg)	9,790

Table 4. Annual Cost per Unit Floor Area

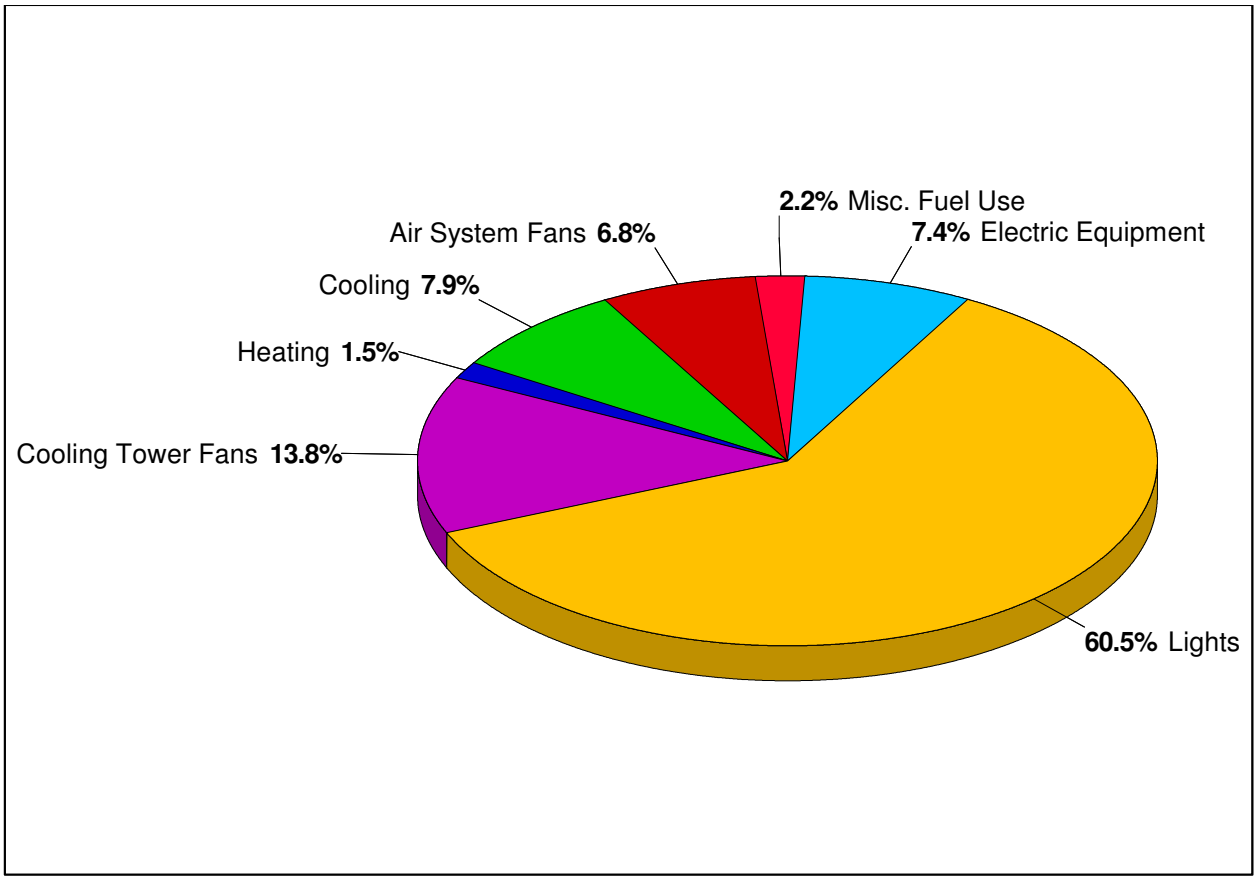
Component	MCCCH ($/ft²)
HVAC Components	
Electric	0.560
Natural Gas	0.168
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	**0.728**
Non-HVAC Components	
Electric	1.648
Natural Gas	0.053
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	**1.701**
Grand Total	**2.429**
Gross Floor Area (ft²)	174623.0
Conditioned Floor Area (ft²)	174623.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 5. Component Cost as a Percentage of Total Cost

Component	MCCCH (%)
HVAC Components	
Electric	23.0
Natural Gas	6.9
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	**30.0**
Non-HVAC Components	
Electric	67.8
Natural Gas	2.2
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	**70.0**
Grand Total	**100.0**

Annual Component Costs - MCCCH



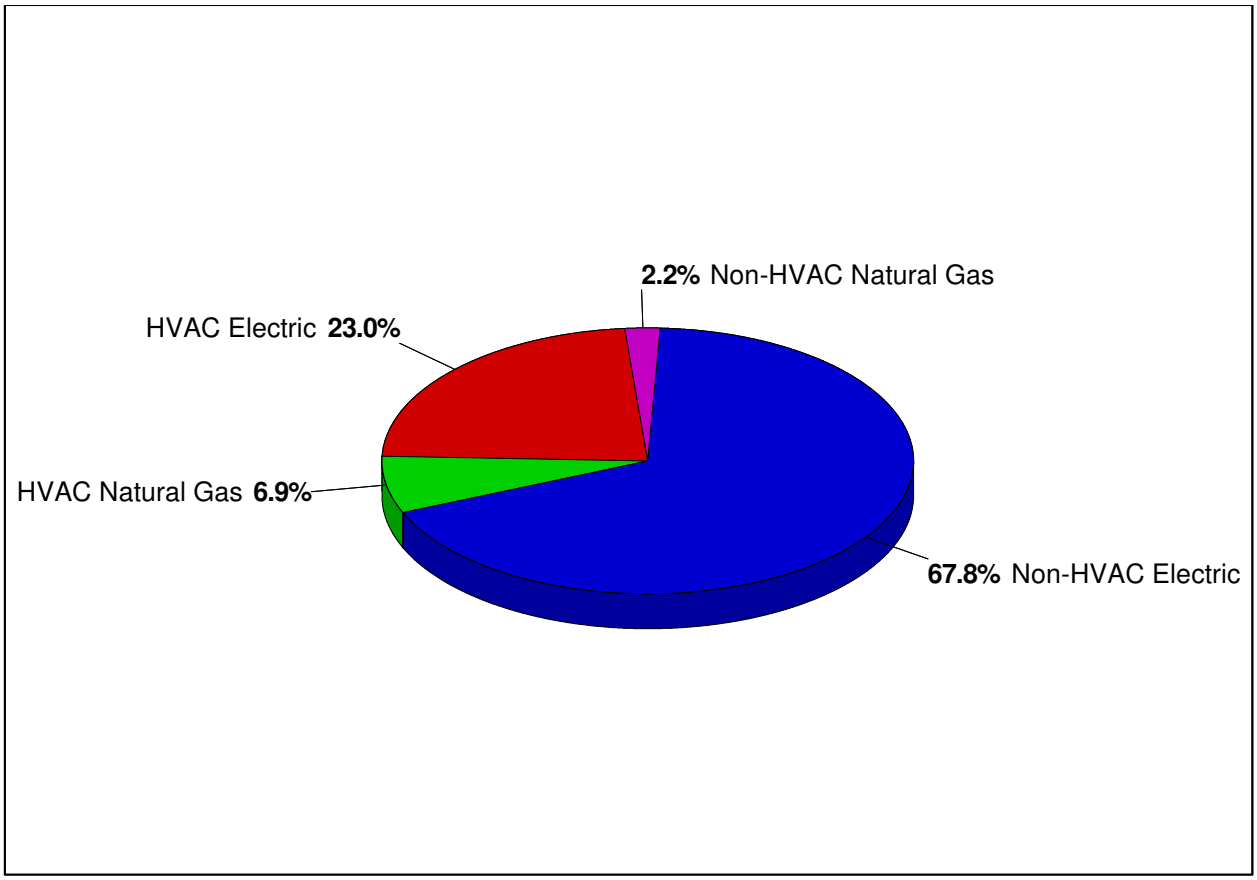
1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	28,909	0.166	6.8
Cooling	33,518	0.192	7.9
Heating	6,234	0.036	1.5
Pumps	0	0.000	0.0
Cooling Tower Fans	58,451	0.335	13.8
HVAC Sub-Total	**127,112**	**0.728**	**30.0**
Lights	256,523	1.469	60.5
Electric Equipment	31,208	0.179	7.4
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	9,309	0.053	2.2
Non-HVAC Sub-Total	**297,040**	**1.701**	**70.0**
Grand Total	**424,151**	**2.429**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **174623.0** ft²
Conditioned Floor Area ..... **174623.0** ft²

Annual Energy Costs - MCCCH



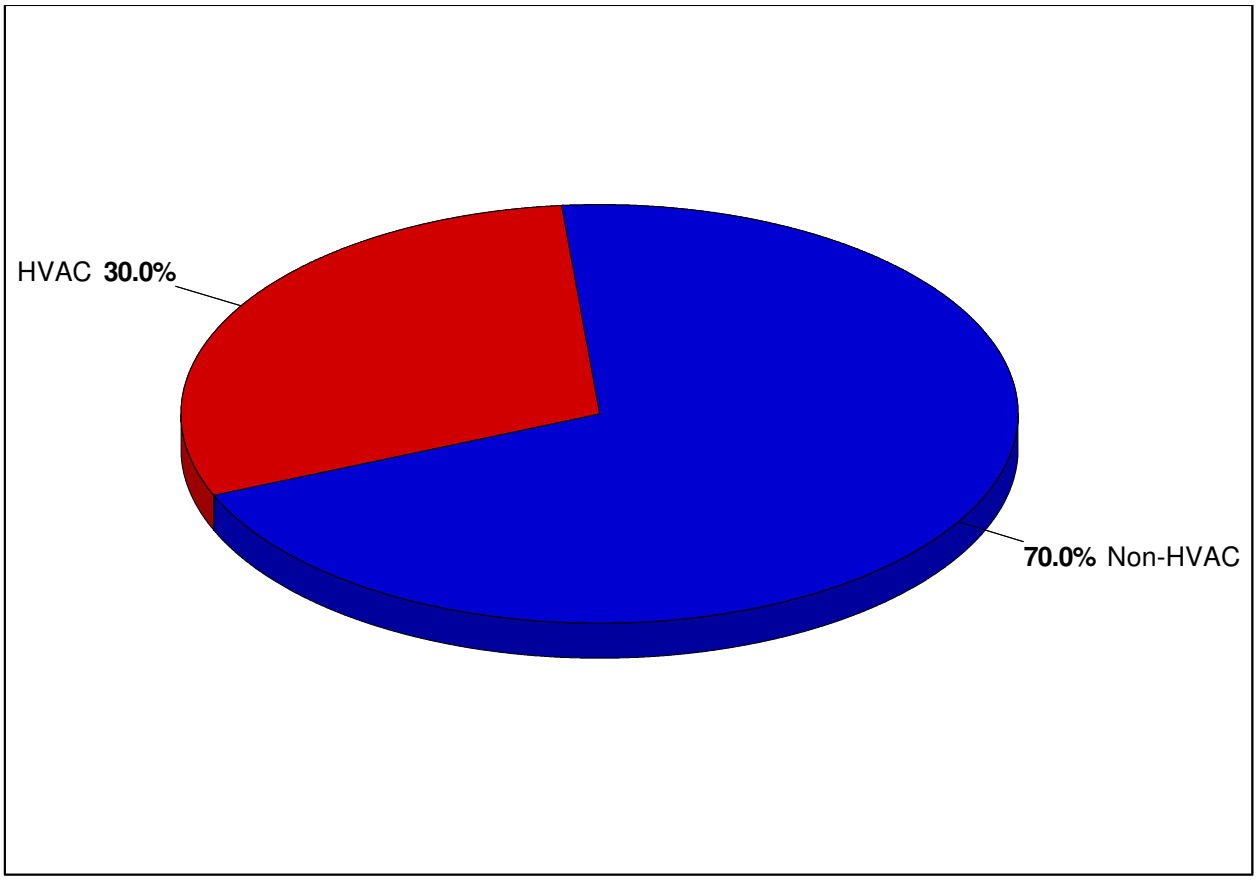
1. Annual Costs

Component	Annual Cost ($/yr)	($/ft²)	Percent of Total (%)
HVAC Components			
Electric	97,753	0.560	23.0
Natural Gas	29,358	0.168	6.9
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	**127,112**	**0.728**	**30.0**
Non-HVAC Components			
Electric	287,729	1.648	67.8
Natural Gas	9,309	0.053	2.2
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	**297,038**	**1.701**	**70.0**
Grand Total	**424,150**	**2.429**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **174623.0** ft²
Conditioned Floor Area ..... **174623.0** ft²

Annual HVAC & Non-HVAC Cost Totals - MCCCH



1. Annual Costs

Component	Annual Cost ($/yr)	($/ft²)	Percent of Total (%)
HVAC	127,112	0.728	30.0
Non-HVAC	297,040	1.701	70.0
Grand Total	**424,151**	**2.429**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **174623.0** ft²
Conditioned Floor Area ..... **174623.0** ft²

Energy Budget by System Component - MCCCH

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10/27/2004
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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	10,001,260	57.273
Heating Coil Loads	2,252,147	12.897
Grand Total	**12,253,402**	**70.171**

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	732,543	4.195	2,616,224	14.982
Cooling	13,271,306	76.000	13,895,985	79.577
Heating	2,655,276	15.206	2,707,839	15.507
Pumps	0	0.000	0	0.000
Cooling Towers	1,481,197	8.482	5,289,990	30.294
HVAC Sub-Total	**18,140,322**	**103.883**	**24,510,037**	**140.360**
Lights	6,500,219	37.224	23,215,068	132.944
Electric Equipment	790,795	4.529	2,824,267	16.174
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	4,726,330	27.066	4,726,330	27.066
Non-HVAC Sub-Total	**12,017,344**	**68.819**	**30,765,665**	**176.183**
Grand Total	**30,157,666**	**172.702**	**55,275,702**	**316.543**

Notes:
1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
   Gross Floor Area ..... **174623.0** ft²
   Conditioned Floor Area ..... **174623.0** ft²

Energy Budget by Energy Source - MCCCH

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10/27/2004
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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	10,001,260	57.273
Heating Coil Loads	2,252,147	12.897
Grand Total	**12,253,402**	**70.171**

2. Energy Consumption by Energy Source

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
HVAC Components				
Electric	2,477,119	14.186	8,846,851	50.663
Natural Gas	15,663,213	89.697	15,663,213	89.697
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Remote Chilled Water	0	0.000	0	0.000
HVAC Sub-Total	**18,140,332**	**103.883**	**24,510,064**	**140.360**
Non-HVAC Components				
Electric	7,290,986	41.753	26,039,236	149.117
Natural Gas	4,726,330	27.066	4,726,330	27.066
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Non-HVAC Sub-Total	**12,017,316**	**68.819**	**30,765,566**	**176.183**
Grand Total	**30,157,648**	**172.701**	**55,275,630**	**316.543**

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
   Gross Floor Area ..... **174623.0** ft²
   Conditioned Floor Area ..... **174623.0** ft²