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Executive Summary of
ASHRAE std 90.1-2004 as applied to
Johns Hopkins Hospital **M**edical **O**ffice **B**uilding.

The MOB is an 88,000 square foot building located in Baltimore Maryland. It consists of four floors, Basement, First, Second and Third. The building is served by six, nearly identical packaged rooftop dx units.

Four of the air handling units, one through four, serve the Basement, First and Second floors. The Third floor is served by AHUs 5 and 6.

In this technical report, the MOB will be evaluated in terms of compliance with std 90.1-2004 for envelope compliance and electrical usage. The lost rentable space and mechanical system first cost will be given. The building will be evaluated in terms of its LEED rating. An energy simulation has also been run on the MOB using HAP, the simulation results will be shown and discussed.

Standard 90.1-2004 Envelope Compliance and Lighting

ASHRAE Std 90.1 is often referred to as the energy standard because it's purpose is to encourage acceptable energy efficiency in buildings. In this technical report the degree of the MOBs compliance with the envelope criteria and lighting criteria will be evaluated.

Envelope Compliance

The building envelope section of Std 90.1 gives different minimum guidelines for envelope construction based on the buildings general type of construction and the climactic zone it is located in.

The climactic zones range from zone 1 in Miami, Hawaii and Puerto Rico, to zone 7 in the northern parts of Maine, Wisconsin, North Dakota and Michigan. The MOB, being in Baltimore Maryland, is in zone 4A. Accordingly its appropriate envelope criteria are found on Table 5.5-4.

The minimum criteria for the walls and roof are simply a function of their construction and the type of building being evaluated. The building types are Nonresidential, Residential and Semiheated. The MOB is a Nonresidential building.

The minimum criteria for building fenestration, which includes the glass curtain walls in the two stairwells and the main entrance atrium, is based on the percentage of the building that is constructed of glazing.

The first upcoming chart is the Envelope Area Chart. It gives a breakdown of the buildings envelope, including its exterior glazing organized by floor and building elevation direction.

The second chart is the Component Compliance Chart. It shows the constituent component of each building section as well as whether or not that component meets minimum criteria for R, U and SHGC values.

Calculation Assumptions and Notes

Assumption 1 – Mechanical pad heat losses are acceptable and negligible.

Assumption 2 – Glazing areas consist of two layers of 1/8” clear glass separated by ¼” of air space. This will not meet maximum U and SHGC values. But upon inspection with HAP, it was found that none of the 1/8” panes met both SHGC and U value limits.

Note 1 – The rigid tapered insulation goes from a maximum thickness at the parapets of approximately 7” to a minimum thickness of 2” at the roof drains. The overall R value of the roof assembly with only 2” of insulation is 14.84, which is close enough to the required value of 15 to be negligible.

Assumption 3 – Minimum roof R value can be neglected because it is very close (14.84) to the minimum of 15 and occurs over a very small area.

Envelope Area Chart

Window Height Key	
top row height	4'-8"
bottom row height	6'-8"typical or 5'-11 in 1st & LL West Elevation

	Envelope Section	floor height ft	perimeter ft	area ft^2	3'-6" qty	4'-0" qty	4'-6" qty	6'-6" qty	area ft^2	Glazing Area ft^2
3rd FLOOR	East Elevation	13.33	302.5	3118						
	East Fenestration					6	19	4	915	853
	North Elevation	13.33	65.5	694						
	North Fenestration						3	2	179	
	West Elevation	13.33	527	5969						
	West Fenestration				5	32	1	1	1056	
	South Elevation	13.33	82	853						
	South Fenestration						5	2	240	
2nd FLOOR	East Elevation	13.33	302.5	3118						
	East Fenestration					6	19	4	915	853
	North Elevation	13.33	65.5	694						
	North Fenestration						3	2	179	
	West Elevation	13.33	527	5969						
	West Fenestration				5	32	1	1	1056	
	South Elevation	13.33	82	853						
	South Fenestration						5	2	240	
1st FLOOR	East Elevation	13.33	302.5	3174			12	3	349	
	East Fenestration					6	10	1	510	853
	North Elevation	13.33	65.5	747			3	2	126	
	North Fenestration								0	
	West Elevation	13.33	208	2412						
	West Fenestration				1	6	6	1	361	

	South Elevation	13.33	82	867				
	South Fenestration					6	1	226
	East Elevation			0				
	East Fenestration							0
LOWER LEVEL	North Elevation	14.33	82.5	1018				
	North Fenestration				1	4	2	164
	West Elevation	14.33	137.5	1781				
	West Fenestration				8			189
	South Elevation			0				
	South Fenestration							0

		Sums by Elevation				**Sums by Level**			
	East	North	West	South	3rd	2nd	1st	LL
Walls	9,409	3,154	16,130	2,574	10,634	10,634	7,199	2,799
Total	31,266							
Glazing	5,247	648	2,663	705	3,243	3,243	2,425	353
Total	9,263							

Roof Area	18,504.50
Mech Pad Area	5,786.00
% Glazing	22.9

Compliance Chart for R value, U value and SHGC

Unit	Material	Thickness inch	R value hr*ft^2*F/BTU
Wall	Gypsum Board	0.625	0.56
	Air Space	0	0.91
	8” LW Concrete Block	8	2.02
	R-14 Board Insulation	2	13.89
	Air Space	1	0.91
	Face Brick	4	0.433
Roof	Steel Deck	0.034	0.00011
	Rigid Tapered Insulation	5	34.72
	1/2” Plywood	0.5	0.62
	Built Up Roofing	0.376	0.33
Windows	1/8” Clear Glass	0.125	
	1/4” Air Space	0.25	
	1/8” Clear Glass	0.125	
			U=.57
			SC=.887
			SHGC=.763

Wall	Design R value	Std 90.1 R value (minimum value)	PASS
	18.723	5.7	**YES**

Roof		(minimum value)	
	35.670	15	**YES**

Windows		Assembly U value (maximum value)	
	Fixed window	0.57	**YES**
	Operable window	0.67	**YES**
		U=.57	

		Assembly SHGC (maximum value)	
	All	0.39	**NO**
	North Facing	0.49	**NO**
		SHGC=.763	

Conclusions on Envelope Compliance

The mass walls and roof of the MOB outperformed Std 90.1-2004 minimum R-values quite well. Although the window Solar Heat Gain Coefficient turned out to be too high and fail the to meet recommended maximum values. The possible SHGC values were evaluated using HAPs window construction feature with different pane types being utilized. With the best performing 1/8" panes, bronze tinted panes, the SHGC values were still unacceptable. In fact, there were only three outer panes that yielded sufficiently low SHGC values. These panes were gray reflective, bronze reflective, and blue-green reflective panes.

Electrical Usage Compliance

There are two methods of checking a building for electrical usage compliance. The first, and more simple, is the Building Area Method. This method uses the overall floor area and fits into a classification that determines the recommended wattage per square foot used in lighting. The second method is the Space-by-Space Method. This method uses separate watt per square foot guidelines for different spaces within a building. The different categories are multiplied with their specific power density values and then summed.

The MOB will be evaluated with the Building Area Method. It will be approximated as office space. The second closest space is a hospital designation, which is far and beyond the requirements of a partial use facility such as a medical office.

The following chart shows the allowed energy usage on a Watt/sqft and usable area basis versus the actual energy consumption of the building.

Calculation Assumptions and Notes

Assumption 1 – The actual energy usage can be approximated by assuming all lighting circuits carry 15 Amps, which seems appropriate as the 20 Amp circuit breakers are recommended to carry 16 Amps.

Assumption 2 – Emergency lighting is disregarded.

Assumption 3 – Exterior lighting is disregarded.

Assumption 4 – Irregular lighting, such as under counter fluorescent strips, Infra-Red sink lighting, and examination lights are disregarded as they are not normally used.

Assumption 5 – Only mechanical shafts are disregarded when the usable building area is calculated.

Electrical Usage Chart

Area

Total Building Area	Exempted Area	Adjusted Area
88,260	491	87,769

Allowed Power Use

Allowed power density as per Std 90.1-2004 Table 9.5.1 for Building Area Method

Office Use (W/ft^2)	Adjusted Area	Total Power Allowed
1.1	87,769	**96,546**

Actual Power Use

Circuits	Unit Amperage	Voltage	Power (Watts)
44	15	277	**182,820**

Conclusions on Electrical Usage

The MOB does NOT meet Std 90.1-2004 guidelines for electrical usage. Assumption 1, which regulates the actual power use, was questioned. However, even with an assumed load of only 8 Amps per 20 Amp circuit, the building still overshoots the recommended energy usage as per Std 90.1-2004.

Building Lost Rentable Space

The lost rentable space in the MOB is relatively low. This is because there are no internal mechanical rooms due to the fact that the AHUs are all located on the roof. The only major mechanical loss space is the two larger mechanical shafts and the main electrical and plumbing rooms, which are located in the southwestern corner of the Lower Level. The percentage of the space lost to mechanical is actually below 2%.

Building Lost Rentable Space

Space Name	Area (ft^2)
SUM OF SHAFTS	491
BR-B057 ELEC	246
MES A1 ELEC	69
MES A2 ELEC	66
MES A3 ELEC	66
MES AB ELEC	69
MR-B055 PLUMBING	178
MES B2 ELEC	64
MES B3 ELEC	64
MES BB	68
LOST RENTABLE SPACE	**1,381**
Total Building Area	**88,260**
% of Space Lost	**1.56**

First Cost of Mechanical System

The first cost of materials and labor for the mechanical system is $1,400,000. This amount was determined by reading the contract documents provided by Leach Wallace Associates, Inc. The installation cost was given as such.

In the decision making process involved in Johns Hopkins Hospital MOB, first cost was the deciding factor. The building is on the very same block as the Hopkins campus central boiler and chiller plant, which is under capacity. The first cost of the system used is 1.4 million dollars. The first cost of a more efficient district chilled water and steam system is 1.7 million. Because of this discrepancy, the MOB uses air cooled DX units and a VAV with electric re-heat terminals, a very inefficient system.

LEED Assessment of JHH MOB

LEED assessment is a process by which a buildings design may be analyzed for it's environmental impact. The lower its negative environmental impact the higher LEED certification is may receive. The MOB was not designed to meet any level of LEED certification and therefore will not score many points on the LEED assessment.

The following chart is the checklist used to gauge points awarded for towards LEED certification.

Project Checklist

Y	N	Sustainable Sites		14 Possible Points
		Prereq 1	Erosion & Sedimentation Control	Required
	1	Credit 1	Site Selection	1
1		Credit 2	Urban Redevelopment	1
	1	Credit 3	Brownfield Redevelopment	1
1		Credit 4.1	Alternative Transportation, Public Transportation Access	1
	1	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
	1	Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles	1
	1	Credit 4.4	Alternative Transportation, Parking Capacity	1
	1	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space	1
	1	Credit 5.2	Reduced Site Disturbance, Development Footprint	1
	1	Credit 6.1	Stormwater Management, Rate and Quantity	1
	1	Credit 6.2	Stormwater Management, Treatment	1
	1	Credit 7.1	Heat Island Effect, Non-Roof	1
	1	Credit 7.2	Heat Island Effect, Roof	1
	1	Credit 8	Light Pollution Reduction	1

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

Y	N	Energy & Atmosphere		17 Possible Points
		Prereq 1	Fundamental Building Systems Commissioning	Required
		Prereq 2	Minimum Energy Performance	Required
		Prereq 3	CFC Reduction in HVAC&R Equipment	Required
	1	Credit 1	Optimize Energy Performance	1–10
1		Credit 2.1	Renewable Energy, 5%	1
	1	Credit 2.2	Renewable Energy, 10%	1
	1	Credit 2.3	Renewable Energy, 20%	1
	1	Credit 3	Additional Commissioning	1
	1	Credit 4	Ozone Depletion	1
	1	Credit 5	Measurement & Verification	1
	1	Credit 6	Green Power	1

Y	N	Materials & Resources		13 Possible Points
		Prereq 1	Storage & Collection of Recyclables	Required
	1	Credit 1.1	Building Reuse, Maintain 75% of Existing Shell	1
	1	Credit 1.2	Building Reuse, Maintain 100% of Shell	1
	1	Credit 1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell	1
	1	Credit 2.1	Construction Waste Management, Divert 50%	1
	1	Credit 2.2	Construction Waste Management, Divert 75%	1
	1	Credit 3.1	Resource Reuse, Specify 5%	1
	1	Credit 3.2	Resource Reuse, Specify 10%	1
	1	Credit 4.1	Recycled Content, Specify 5% (p.c. + 1/2 p.i.)	1
	1	Credit 4.2	Recycled Content, Specify 10% (p.c. + 1/2 p.i.)	1
	1	Credit 5.1	Local/Regional Materials, 20% Manufactured Locally	1
	1	Credit 5.2	Local/Regional Materials, of 20% in MRc5.1, 50% Harvested Locally	1
	1	Credit 6	Rapidly Renewable Materials	1
	1	Credit 7	Certified Wood	1

Y	N	Indoor Environmental Quality		15 Possible Points
		Prereq 1	Minimum IAQ Performance	Required
		Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
	1	Credit 1	Carbon Dioxide (CO_2) Monitoring	1
1		Credit 2	Ventilation Effectiveness	1
	1	Credit 3.1	Construction IAQ Management Plan, During Construction	1
	1	Credit 3.2	Construction IAQ Management Plan, Before Occupancy	1
	1	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1
	1	Credit 4.2	Low-Emitting Materials, Paints	1
	1	Credit 4.3	Low-Emitting Materials, Carpet	1
	1	Credit 4.4	Low-Emitting Materials, Composite Wood	1
	1	Credit 5	Indoor Chemical & Pollutant Source Control	1
	1	Credit 6.1	Controllability of Systems, Perimeter	1
	1	Credit 6.2	Controllability of Systems, Non-Perimeter	1
	1	Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992	1
	1	Credit 7.2	Thermal Comfort, Permanent Monitoring System	1
	1	Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1
	1	Credit 8.2	Daylight & Views, Views for 90% of Spaces	1

Y	N	Innovation & Design Process		5 Possible Points
	1	Credit 1.1	Innovation in Design	1
	1	Credit 1.2	Innovation in Design	1
	1	Credit 1.3	Innovation in Design	1
	1	Credit 1.4	Innovation in Design	1
		Credit 2	LEED™ Accredited Professional	1

	Project Totals	69 Possible Points
4	Not Certified	<26 points
	Certified	26-32 points
	Silver	33-38 points
	Gold	39-51 points
	Platinum	52-69 points

Conclusion of LEED Assessment

The exceedingly poor LEED rating of the MOB illustrates to what extent first cost rules in the building industry. The buildings only energy input is electric. There has been no effort to use more efficient systems of oil, gas, or the central plant, located about a hundred yards away.

HAP Simulation

Carriers Hourly Analysis Program was chosen to analyze the MOD because it was the program the MEP firm, Leach Wallace Associates, Inc used. The final results will be shown to be lower than the economic estimate LWA predicted in their contract documents. This is possibly because of the omission of load from certain specialized equipment with unknown electric load and heat gain. Another inconsistency is that the cooling loads are exceedingly small and the electrical equipment load enormous. The only conclusion I could come to is that by some error of classification HAP took all of the cooling and heating, which is all electric incidentally, to be equipment load instead of classifying it as cooling and heating.

Simulation Assumptions and Notes

Assumption 1 – Space occupant loads are based on space furniture.

Assumption 2 – Unknown thermal resistance values, such as those of the basement slab and the basement walls are at the default values found in HAP.

Total Simulated Electricity, Cost, and Emissions

	lbm Pollutant /kWh			
Fuel	**Particulates**	**SO2/kWh**	**Nox/kWh**	**CO2/kWh**
Coal	1.10E-03	1.28E-02	7.41E-03	2.15E+00
Oil	1.10E-03	1.54E-02	2.83E-03	2.11E+00
Nat. Gas	0.00E+00	1.35E-05	2.54E-03	1.34E+00
Nuclear	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydro/Wind	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Totals	**6.42E-04**	**7.54E-03**	**4.44E-03**	**1.38E+00**

	AHU1-2,5	**AHU3-4,6**	**SUM**
Electricity (kWh)	763,646	339,699	**1,103,345**
HAP simulated cost ($)	51,927	23,100	**75,027**

lbm Pollutant yearly			
Particulates	SO2/kWh	Nox/kWh	CO2/kWh
708	**8,319**	**4,899**	**1,522,616**

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kBTU)	Central Heating Coil Input (kWh)	Zone Heating Coil Load (kBTU)	Zone Heating Coil Input (kWh)
January	181784	28	16	0	0	0	0
February	176438	45	15	0	0	0	0
March	216889	250	60	0	0	0	0
April	229531	433	159	0	0	0	0
May	265351	652	367	0	0	0	0
June	305202	699	512	0	0	0	0
July	327438	711	553	0	0	0	0
August	316090	697	529	0	0	0	0
September	285357	705	456	0	0	0	0
October	252282	594	272	0	0	0	0
November	209881	264	81	0	0	0	0
December	191172	67	15	0	0	0	0
Total	**2957414**	**5143**	**3035**	**0**	**0**	**0**	**0**

Air System Simulation Results (Table 2) :

Month	Supply Fan (kWh)	Return Fan (kWh)	Zone Heating Unit Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	10807	2523	0	12714	29610
February	10058	2348	0	11593	27000
March	11652	2720	0	12997	30270
April	11836	2763	0	12340	28740
May	12385	2891	0	12340	28740
June	12610	2944	0	12997	30270
July	13105	3059	0	12714	29610
August	12779	2983	0	12997	30270
September	12430	2902	0	12340	28740
October	12316	2875	0	12714	29610
November	10980	2563	0	12623	29400
December	11004	2569	0	12714	29610
Total	**141960**	**33138**	**0**	**151081**	**351870**

Air System Sizing Summary for AHU1-2

Project Name: LLAHU1-2
Prepared by: psuae

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Air System Information

Air System Name	AHU1-2		Number of zones	4	
Equipment Class	PKG ROOF		Floor Area	28444.0	ft²
Air System Type	VAV		Location	Baltimore, Maryland	

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	110.0	Tons	Load occurs at	Aug 1400	
Total coil load	1320.6	MBH	OA DB / WB	92.4 / 74.8	°F
Sensible coil load	1064.2	MBH	Entering DB / WB	79.4 / 63.0	°F
Coil CFM at Aug 1400	33949	CFM	Leaving DB / WB	50.2 / 48.8	°F
Max block CFM at Aug 1500	34220	CFM	Coil ADP	46.9	°F
Sum of peak zone CFM	34248	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.806		Resulting RH	40	%
ft²/Ton	258.5		Design supply temp.	55.0	°F
BTU/(hr-ft²)	46.4		Zone T-stat Check	1 of 4	OK
Water flow @ 10.0 °F rise	N/A		Max zone temperature deviation	3.3	°F

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Aug 1500	34220	CFM	Fan motor BHP	69.40	BHP
Standard CFM	34030	CFM	Fan motor kW	51.75	kW
Actual max CFM/ft²	1.20	CFM/ft²			

Return Fan Sizing Data

Actual max CFM at Aug 1500	34220	CFM	Fan motor BHP	16.20	BHP
Standard CFM	34030	CFM	Fan motor kW	12.08	kW
Actual max CFM/ft²	1.20	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	4857	CFM	CFM/person	8.45	CFM/person
CFM/ft²	0.17	CFM/ft²			

Air System Design Load Summary for AHU1-2

Project Name: LLAHU1-2
Prepared by: psuae

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	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1400 COOLING OA DB / WB 92.4 °F / 74.8 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 11.0 °F / 8.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1536 ft²	71546	-	1536 ft²	-	-
Wall Transmission	3656 ft²	4143	-	3656 ft²	7224	-
Roof Transmission	1434 ft²	2831	-	1434 ft²	1524	-
Window Transmission	1536 ft²	14902	-	1536 ft²	34140	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	9316 ft²	0	-	9316 ft²	3996	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	42936 W	115923	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	100000 W	309431	-	0	0	-
People	575	101409	96880	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	500	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	620686	96880	-	46883	0
Zone Conditioning	-	769170	96880	-	36848	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	33949 CFM	40925	-	342 CFM	-8904	-
Ventilation Load	4818 CFM	76746	159469	49 CFM	3226	-154
Supply Fan Load	33949 CFM	175323	-	342 CFM	-38143	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	1064165	256349	-	-6973	-154
Central Cooling Coil	-	1064165	256408	-	-41462	-154
Central Heating Coil	-	0	-	-	0	-
Zone Heating Unit Coils	-	0	-	-	34489	-
>> Total Conditioning	-	1064165	256408	-	-6973	-154
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

System Psychrometrics for AHU1-2

Project Name: LLAHU1-2
Prepared by: psuae

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August DESIGN COOLING DAY, 1400

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	92.4	0.01463	4818	400	78746	159469
Vent - Return Mixing	Outlet	79.4	0.00861	33949	1459	-	-
Central Cooling Coil	Outlet	50.2	0.00701	33949	1459	1064165	256408
Central Heating Coil	Outlet	50.2	0.00701	33949	1459	0	-
Supply Fan	Outlet	55.0	0.00701	33949	1459	175323	-
Cold Supply Duct	Outlet	55.0	0.00701	33949	1459	-	-
Zone Air	-	76.1	0.00761	33949	1634	769170	96880
Return Plenum	Outlet	76.1	0.00761	33949	1634	0	-
Return Fan	Outlet	77.2	0.00761	33949	1634	40925	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.074 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4720.2 BTU/(hr-CFM)
Site Altitude = 154.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	141916	Cooling	194339	78.3	7773	1820	0	0
Zone 2	75611	Cooling	101944	77.7	4178	1731	0	0
Zone 3	373181	Cooling	435455	74.9	20325	1547	0	0
Zone 4	29777	Cooling	37433	75.8	1673	1576	0	0

System Psychrometrics for AHU1-2

Project Name: LLAHU1-2
Prepared by: psuae

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01:46PM

August DESIGN COOLING DAY, 1400

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	92.4	0.01463	4818	400	78746	159469
Vent - Return Mixing	Outlet	79.4	0.00861	33949	1459	-	-
Central Cooling Coil	Outlet	50.2	0.00701	33949	1459	1064165	256408
Central Heating Coil	Outlet	50.2	0.00701	33949	1459	0	-
Supply Fan	Outlet	55.0	0.00701	33949	1459	175323	-
Cold Supply Duct	Outlet	55.0	0.00701	33949	1459	-	-
Zone Air	-	76.1	0.00761	33949	1634	769170	96880
Return Plenum	Outlet	76.1	0.00761	33949	1634	0	-
Return Fan	Outlet	77.2	0.00761	33949	1634	40925	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.074 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4720.2 BTU/(hr-CFM)
Site Altitude = 154.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	141916	Cooling	194339	78.3	7773	1620	0	0
Zone 2	75611	Cooling	101944	77.7	4178	1731	0	0
Zone 3	373181	Cooling	435455	74.9	20325	1547	0	0
Zone 4	29777	Cooling	37433	75.8	1673	1576	0	0

Monthly Simulation Results for AHU3-4

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:38PM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kBTU)	Central Heating Coil Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)
January	48490	13	7	12	4	0	0
February	52119	25	11	21	6	0	0
March	76154	62	36	0	0	0	0
April	104200	120	77	0	0	0	0
May	149255	213	152	0	0	0	0
June	185248	412	327	0	0	0	0
July	221504	522	423	0	0	0	0
August	201522	443	357	0	0	0	0
September	172060	315	239	0	0	0	0
October	127416	185	125	0	0	0	0
November	76827	49	31	0	0	0	0
December	52489	12	1	0	0	0	0
Total	1467302	2373	1788	33	10	0	0

Air System Simulation Results (Table 2) :

Month	Zone Heating Coil Load (kBTU)	Zone Heating Coil Input (kWh)	Supply Fan (kWh)	Return Fan (kWh)	Zone Heating Unit Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	5426	1304	0	12165	0
February	14	4	5399	1297	0	10779	0
March	0	0	7439	1787	0	11627	0
April	0	0	8649	2078	0	11703	0
May	0	0	9975	2397	0	12089	0
June	0	0	9783	2351	0	11241	0
July	0	0	10695	2570	0	12165	0
August	0	0	10145	2438	0	11627	0
September	0	0	9891	2377	0	11703	0
October	0	0	9178	2205	0	12165	0
November	0	0	6776	1628	0	11166	0
December	0	0	5505	1323	0	12165	0
Total	14	4	98860	23753	0	140595	0

Air System Sizing Summary for AHU3-4

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:34PM

Air System Information

Air System Name	AHU3-4	Number of zones	4
Equipment Class	PKG ROOF	Floor Area	29644.0 ft²
Air System Type	VAV	Location	Baltimore, Maryland

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	82.6	Tons	Load occurs at	Jul 1500	
Total coil load	991.2	MBH	OA DB / WB	93.0 / 75.0	°F
Sensible coil load	721.7	MBH	Entering DB / WB	82.6 / 65.2	°F
Coil CFM at Jul 1500	19243	CFM	Leaving DB / WB	47.7 / 46.4	°F
Max block CFM at Aug 1500	19243	CFM	Coil ADP	43.8	°F
Sum of peak zone CFM	19356	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.728		Resulting RH	38	%
ft²/Ton	358.9		Design supply temp.	55.0	°F
BTU/(hr-ft²)	33.4		Zone T-stat Check	0 of 4	OK
Water flow @ 10.0 °F rise	N/A		Max zone temperature deviation	3.1	°F

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Aug 1500	19243	CFM	Fan motor BHP	59.10	BHP
Standard CFM	19136	CFM	Fan motor kW	44.07	kW
Actual max CFM/ft²	0.65	CFM/ft²			

Return Fan Sizing Data

Actual max CFM at Aug 1500	19243	CFM	Fan motor BHP	14.20	BHP
Standard CFM	19136	CFM	Fan motor kW	10.59	kW
Actual max CFM/ft²	0.65	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	4993	CFM	CFM/person	8.73	CFM/person
CFM/ft²	0.17	CFM/ft²			

Air System Design Load Summary for AHU3-4

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:34PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 93.0 °F / 75.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 11.0 °F / 8.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	2329 ft²	90515	-	2329 ft²	-	-
Wall Transmission	7264 ft²	8017	-	7264 ft²	21712	-
Roof Transmission	1342 ft²	2824	-	1342 ft²	2158	-
Window Transmission	2329 ft²	23404	-	2329 ft²	78314	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	8814 ft²	0	-	8814 ft²	6656	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	44397 W	121943	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	572	103952	101875	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	-	350654	101875	-	108840	0
Zone Conditioning	-	462893	101875	-	96310	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	19243 CFM	36131	-	194 CFM	-7806	-
Ventilation Load	4993 CFM	74992	167588	50 CFM	5064	-162
Supply Fan Load	19243 CFM	150375	-	194 CFM	-32486	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	724391	269463	-	61082	-162
Central Cooling Coil	-	721694	269475	-	-37792	-162
Central Heating Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	0	-
Zone Heating Unit Coils	-	0	-	-	98874	-
>> Total Conditioning	-	721694	269475	-	61082	-162
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

System Psychrometrics for AHU3-4

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:34PM

July DESIGN COOLING DAY, 1500

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	93.0	0.01463	4993	400	74992	167588
Vent - Return Mixing	Outlet	82.6	0.00936	19243	1319	-	-
Central Cooling Coil	Outlet	47.7	0.00639	19243	1319	721694	269475
Central Heating Coil	Outlet	47.7	0.00639	19243	1319	0	-
Supply Fan	Outlet	55.0	0.00639	19243	1319	150375	-
Cold Supply Duct	Outlet	55.0	0.00639	19243	1319	-	-
Zone Air	-	77.3	0.00751	19243	1641	462893	101875
Return Plenum	Outlet	77.3	0.00751	19243	1641	0	-
Return Fan	Outlet	79.0	0.00751	19243	1641	36131	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.074 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4720.2 BTU/(hr-CFM)
Site Altitude = 154.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	76442	Cooling	103664	78.1	4162	1657	0	0
Zone 2	154763	Cooling	205702	77.3	8551	1638	0	0
Zone 3	90231	Cooling	117869	77.1	4939	1725	0	0
Zone 4	29218	Cooling	35658	75.7	1591	1357	0	0

Monthly Simulation Results for AHU5

Project Name: LLAHU1-2
Prepared by: psuae

10/31/2005
01:53PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kBTU)	Preheat Coil Input (kWh)	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kBTU)	Central Heating Coil Input (kWh)
January	0	0	15294	13	7	1529	448
February	0	0	16518	25	11	768	225
March	0	0	27226	102	47	17	5
April	0	0	38602	190	109	0	0
May	0	0	54974	304	204	0	0
June	0	0	73062	428	332	0	0
July	0	0	83654	430	345	0	0
August	0	0	76945	427	340	0	0
September	0	0	63670	373	269	0	0
October	0	0	44960	260	160	0	0
November	0	0	24455	77	49	39	11
December	0	0	16392	12	1	1329	390
Total	0	0	535774	2642	1873	3683	1079

Air System Simulation Results (Table 2) :

Month	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)	Zone Heating Coil Load (kBTU)	Zone Heating Coil Input (kWh)	Supply Fan (kWh)	Return Fan (kWh)	Zone Heating Unit Fan (kWh)
January	0	0	187	55	866	367	0
February	0	0	81	24	928	394	0
March	0	0	0	0	1422	603	0
April	0	0	0	0	1715	728	0
May	0	0	0	0	2113	897	0
June	0	0	0	0	2348	997	0
July	0	0	0	0	2560	1087	0
August	0	0	0	0	2395	1017	0
September	0	0	0	0	2213	939	0
October	0	0	0	0	1839	781	0
November	0	0	0	0	1224	519	0
December	0	0	74	22	904	384	0
Total	0	0	343	101	20526	8713	0

Air System Simulation Results (Table 3) :

Air System Sizing Summary for AHU5

Project Name: LLAHU1-2
Prepared by: psuae

10/31/2005
01:51PM

Air System Information

Air System Name	AHU5	Number of zones	2
Equipment Class	PKG ROOF	Floor Area	9349.0 ft²
Air System Type	VAV	Location	Baltimore, Maryland

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	30.6	Tons	Load occurs at	Aug 1400	
Total coil load	367.2	MBH	OA DB / WB	92.4 / 74.8	°F
Sensible coil load	281.6	MBH	Entering DB / WB	81.0 / 64.7	°F
Coil CFM at Aug 1400	8830	CFM	Leaving DB / WB	51.3 / 49.9	°F
Max block CFM at Aug 1400	8830	CFM	Coil ADP	48.0	°F
Sum of peak zone CFM	8865	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.767		Resulting RH	42	%
ft²/Ton	305.6		Design supply temp.	55.0	°F
BTU/(hr-ft²)	39.3		Zone T-stat Check	0 of 2	OK
Water flow @ 10.0 °F rise	N/A		Max zone temperature deviation	2.1	°F

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Aug 1400	8830	CFM	Fan motor BHP	13.90	BHP
Standard CFM	8780	CFM	Fan motor kW	10.37	kW
Actual max CFM/ft²	0.94	CFM/ft²			

Return Fan Sizing Data

Actual max CFM at Aug 1400	8830	CFM	Fan motor BHP	5.90	BHP
Standard CFM	8780	CFM	Fan motor kW	4.40	kW
Actual max CFM/ft²	0.94	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	1529	CFM	CFM/person	7.88	CFM/person
CFM/ft²	0.16	CFM/ft²			

Air System Design Load Summary for AHU5

Project Name: LLAHU1-2
Prepared by: psuae

10/31/2005
01:51PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1400 COOLING OA DB / WB 92.4 °F / 74.8 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 11.0 °F / 8.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1194 ft²	54631	-	1194 ft²	-	-
Wall Transmission	3011 ft²	3228	-	3011 ft²	9001	-
Roof Transmission	9149 ft²	18064	-	9149 ft²	14711	-
Window Transmission	1194 ft²	11582	-	1194 ft²	40139	-
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	14285 W	38567	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	194	35139	39770	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	-	161210	39770	-	63851	0
Zone Conditioning	-	209283	39770	-	59208	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	8830 CFM	15012	-	89 CFM	-3243	-
Ventilation Load	1529 CFM	22773	45755	15 CFM	1487	-43
Supply Fan Load	8830 CFM	35367	-	89 CFM	-7640	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	282436	85525	-	45812	-43
Central Cooling Coil	-	281610	85544	-	-10554	-43
Central Heating Coil	-	0	-	-	0	-
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	0	-
Zone Heating Unit Coils	-	0	-	-	60365	-
>> Total Conditioning	-	281610	85544	-	45812	-43
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

System Psychrometrics for AHU5

Project Name: LLAHU1-2
Prepared by: psuae

10/31/2005
01:51PM

August DESIGN COOLING DAY, 1400

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	92.4	0.01463	1529	400	22773	45755
Vent - Return Mixing	Outlet	81.0	0.00938	8830	1618	-	-
Preheat Coil	Outlet	81.0	0.00938	8830	1618	0	-
Central Cooling Coil	Outlet	51.3	0.00733	8830	1618	281610	85544
Central Heating Coil	Outlet	51.3	0.00733	8830	1618	0	-
Supply Fan	Outlet	55.0	0.00733	8830	1618	35367	-
Cold Supply Duct	Outlet	55.0	0.00733	8830	1618	-	-
Zone Air	-	77.0	0.00828	8830	1873	209283	39770
Return Plenum	Outlet	77.0	0.00828	8830	1873	0	-
Return Fan	Outlet	78.6	0.00828	8830	1873	15012	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.074 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4720.2 BTU/(hr-CFM)
Site Altitude = 154.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	148673	Cooling	193478	77.1	8111	1886	0	0
Zone 2	12536	Cooling	15805	75.4	719	1726	0	0

Monthly Simulation Results for AHU6

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:45PM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kBTU)	Central Heating Coil Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)
January	11593	13	7	1651	484	0	0
February	12398	25	11	838	246	0	0
March	20111	62	36	1	0	0	0
April	29543	120	77	0	0	0	0
May	45503	213	152	0	0	0	0
June	58288	267	215	0	0	0	0
July	70485	273	227	0	0	0	0
August	62721	254	206	0	0	0	0
September	53270	246	184	0	0	0	0
October	35722	185	125	0	0	0	0
November	19765	49	31	125	37	0	0
December	12747	12	1	2316	679	0	0
Total	**432166**	**1719**	**1273**	**4930**	**1445**	**0**	**0**

Air System Simulation Results (Table 2) :

Month	Zone Heating Coil Load (kBTU)	Zone Heating Coil Input (kWh)	Supply Fan (kWh)	Return Fan (kWh)	Zone Heating Unit Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	170	50	715	303	0	3894	0
February	139	41	757	321	0	3451	0
March	0	0	1213	515	0	3722	0
April	0	0	1568	666	0	3746	0
May	0	0	2061	875	0	3870	0
June	0	0	2191	930	0	3598	0
July	0	0	2438	1035	0	3894	0
August	0	0	2261	960	0	3722	0
September	0	0	2136	908	0	3746	0
October	0	0	1698	721	0	3894	0
November	0	0	1099	467	0	3574	0
December	61	18	716	304	0	3894	0
Total	**370**	**108**	**18856**	**8004**	**0**	**45006**	**0**

Air System Sizing Summary for AHU6

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:43PM

Air System Information

Air System Name	AHU6	Number of zones	1
Equipment Class	PKG ROOF	Floor Area	10120.0 ft²
Air System Type	VAV	Location	Baltimore, Maryland

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	27.7	Tons	Load occurs at	Jul 1500	
Total coil load	332.6	MBH	OA DB / WB	93.0 / 75.0	°F
Sensible coil load	257.3	MBH	Entering DB / WB	81.8 / 64.7	°F
Coil CFM at Jul 1500	7721	CFM	Leaving DB / WB	50.7 / 49.3	°F
Max block CFM at Jul 1500	7721	CFM	Coil ADP	47.3	°F
Sum of peak zone CFM	7721	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.774		Resulting RH	40	%
ft²/Ton	365.1		Design supply temp.	55.0	°F
BTU/(hr-ft²)	32.9		Zone T-stat Check	0 of 1	OK
Water flow @ 10.0 °F rise	N/A		Max zone temperature deviation	2.4	°F

Central Heating Coil Sizing Data

No central heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max CFM at Jul 1500	7721	CFM	Fan motor BHP	13.90	BHP
Standard CFM	7678	CFM	Fan motor kW	10.37	kW
Actual max CFM/ft²	0.76	CFM/ft²			

Return Fan Sizing Data

Actual max CFM at Jul 1500	7721	CFM	Fan motor BHP	5.90	BHP
Standard CFM	7678	CFM	Fan motor kW	4.40	kW
Actual max CFM/ft²	0.76	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	1437	CFM	CFM/person	8.98	CFM/person
CFM/ft²	0.14	CFM/ft²			

Air System Design Load Summary for AHU6

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:43PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 93.0 °F / 75.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 11.0 °F / 8.6 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	969 ft²	38111	-	969 ft²	-	-
Wall Transmission	3188 ft²	3498	-	3188 ft²	9530	-
Roof Transmission	10120 ft²	21297	-	10120 ft²	16272	-
Window Transmission	969 ft²	9735	-	969 ft²	32575	-
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	14212 W	39035	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	160	29300	30165	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	-	140977	30165	-	58376	0
Zone Conditioning	-	185673	30165	-	53776	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	7721 CFM	15012	-	77 CFM	-3243	-
Ventilation Load	1437 CFM	21297	45096	14 CFM	1470	-44
Supply Fan Load	7721 CFM	35367	-	77 CFM	-7639	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	257349	75261	-	44365	-44
Central Cooling Coil	-	257349	75266	-	-10422	-44
Central Heating Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	0	-
Zone Heating Unit Coils	-	0	-	-	54787	-
>> Total Conditioning	-	257349	75266	-	44365	-44
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

System Psychrometrics for AHU6

Project Name: LL AHU3-4
Prepared by: psuae

10/31/2005
01:43PM

July DESIGN COOLING DAY, 1500

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	93.0	0.01463	1437	400	21297	45096
Vent - Return Mixing	Outlet	81.8	0.00921	7721	1405	-	-
Central Cooling Coil	Outlet	50.7	0.00715	7721	1405	257349	75266
Central Heating Coil	Outlet	50.7	0.00715	7721	1405	0	-
Supply Fan	Outlet	55.0	0.00715	7721	1405	35367	-
Cold Supply Duct	Outlet	55.0	0.00715	7721	1405	-	-
Zone Air	-	77.4	0.00798	7721	1634	185673	30165
Return Plenum	Outlet	77.4	0.00798	7721	1634	0	-
Return Fan	Outlet	79.2	0.00798	7721	1634	15012	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.074 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4720.2 BTU/(hr-CFM)
Site Altitude = 154.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	140977	Cooling	185673	77.4	7721	1634	0	0

Annual Cost Summary

Table 1. Annual Costs

Component	MOB AHU1-2,5 ($)
Air System Fans	13,895
Cooling	334
Heating	80
Pumps	0
Cooling Tower Fans	0
HVAC Sub-Total	**14,309**
Lights	13,691
Electric Equipment	23,927
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**37,619**
Grand Total	**51,927**

Table 2. Annual Cost per Unit Floor Area

Component	MOB AHU1-2,5 ($/ft²)
Air System Fans	0.368
Cooling	0.009
Heating	0.002
Pumps	0.000
Cooling Tower Fans	0.000
HVAC Sub-Total	**0.379**
Lights	0.362
Electric Equipment	0.633
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**0.995**
Grand Total	**1.374**
Gross Floor Area (ft²)	37793.0
Conditioned Floor Area (ft²)	37793.0

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

Table 3. Component Cost as a Percentage of Total Cost

Component	MOB AHU1-2,5 (%)
Air System Fans	26.8
Cooling	0.6
Heating	0.2
Pumps	0.0
Cooling Tower Fans	0.0
HVAC Sub-Total	**27.6**
Lights	26.4
Electric Equipment	46.1
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	**72.4**
Grand Total	**100.0**

Table 1. Annual Costs

Component	MOB AHU1-2,5 ($)
HVAC Components	
Electric	14,309
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**14,309**
Non-HVAC Components	
Electric	37,619
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**37,619**
Grand Total	**51,928**

Table 2. Annual Energy Consumption

Component	MOB AHU1-2,5
HVAC Components	
Electric (kWh)	210,425
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	553,221
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	763,646
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Annual Cost Summary

Table 1. Annual Costs

Component	MOB AHU3-4,6 ($)
Air System Fans	10,164
Cooling	208
Heating	107
Pumps	0
Cooling Tower Fans	0
HVAC Sub-Total	**10,479**
Lights	12,621
Electric Equipment	0
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**12,621**
Grand Total	**23,100**

Table 2. Annual Cost per Unit Floor Area

Component	MOB AHU3-4,6 ($/ft²)
Air System Fans	0.256
Cooling	0.005
Heating	0.003
Pumps	0.000
Cooling Tower Fans	0.000
HVAC Sub-Total	**0.264**
Lights	0.317
Electric Equipment	0.000
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**0.317**
Grand Total	**0.581**
Gross Floor Area (ft²)	39764.0
Conditioned Floor Area (ft²)	39764.0

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

Table 3. Component Cost as a Percentage of Total Cost

Component	MOB AHU3-4,6 (%)
Air System Fans	44.0
Cooling	0.9
Heating	0.5
Pumps	0.0
Cooling Tower Fans	0.0
HVAC Sub-Total	**45.4**
Lights	54.6
Electric Equipment	0.0
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	**54.6**
Grand Total	**100.0**

Table 1. Annual Costs

Component	MOB AHU3-4,6 ($)
HVAC Components	
Electric	10,479
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	10,479
Non-HVAC Components	
Electric	12,621
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	12,621
Grand Total	23,100

Table 2. Annual Energy Consumption

Component	MOB AHU3-4,6
HVAC Components	
Electric (kWh)	154,100
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	185,599
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	339,699
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0