

# System Checksums

By ae

AHU-1 (Atrium & North Offices)

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK				CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES		
Peaked at Time:		Mo/Hr: 7 / 15		Mo/Hr: 7 / 9		Mo/Hr: 13 / 1						Cooling		Heating
Outside Air:		OADB/WB/HR: 91 / 77 / 118		OADB: 78		OADB: 13						SADB	55.0	83.5
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total	Space Sensible	Percent Of Total	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total				Plenum	76.6	67.6
Btu/h	Btu/h	Btu/h	(%)	Btu/h	(%)	Btu/h	Btu/h	(%)				Return	77.4	67.6
<b>Envelope Loads</b>				<b>Envelope Loads</b>				<b>Envelope Loads</b>						
Skylite Solar	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	Ret/OA	81.6	48.8
Skylite Cond	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	Fn MtrTD	0.3	0.0
Roof Cond	0	19,900	2.10	0	0.00	0	-45,321	7.91	0	0	0.00	Fn BldTD	0.7	0.0
Glass Solar	137,789	0	137,789	14.52	217,969	45.53	0	0.00	0	0	0.00	Fn Frict	2.2	0.0
Glass Cond	22,830	0	22,830	2.41	4,409	0.92	-83,305	14.54	-83,305	14.54				
Wall Cond	1,346	2,778	4,124	0.43	1,798	0.38	-3,252	1.84	-10,569	1.84				
Partition	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00			
Exposed Floor	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00			
Infiltration	0	0	0.00	0	0.00	0	-7	0.00	-7	0.00				
<b>Sub Total ==&gt;</b>	<b>161,965</b>	<b>22,679</b>	<b>184,643</b>	<b>19.46</b>	<b>224,176</b>	<b>46.83</b>	<b>-86,564</b>	<b>24.29</b>	<b>-139,202</b>	<b>24.29</b>				
<b>Internal Loads</b>				<b>Internal Loads</b>				<b>Internal Loads</b>						
Lights	126,658	31,665	158,323	16.69	126,658	26.46	0	0.00	0	0	0.00			
People	169,412	0	169,412	17.86	98,031	20.48	0	0.00	0	0	0.00			
Misc	14,456	0	14,456	1.52	14,456	3.02	0	0.00	0	0	0.00			
<b>Sub Total ==&gt;</b>	<b>310,526</b>	<b>31,665</b>	<b>342,191</b>	<b>36.07</b>	<b>239,145</b>	<b>49.96</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Ceiling Load</b>	<b>20,579</b>	<b>-20,579</b>	<b>0</b>	<b>0.00</b>	<b>14,947</b>	<b>3.12</b>	<b>-31,497</b>	<b>0.00</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Ventilation Load</b>	<b>0</b>	<b>0</b>	<b>352,971</b>	<b>37.20</b>	<b>0</b>	<b>0.00</b>	<b>-172,590</b>	<b>30.12</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Ov/Undr Sizing</b>	<b>117</b>	<b>0</b>	<b>117</b>	<b>0.01</b>	<b>431</b>	<b>0.09</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Exhaust Heat</b>	<b>0</b>	<b>-15,715</b>	<b>-15,715</b>	<b>-1.66</b>	<b>0</b>	<b>0.00</b>	<b>7,277</b>	<b>-1.27</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Sup. Fan Heat</b>	<b>0</b>	<b>0</b>	<b>67,614</b>	<b>7.13</b>	<b>0</b>	<b>0.00</b>	<b>-177,315</b>	<b>30.94</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Ret. Fan Heat</b>	<b>0</b>	<b>0</b>	<b>16,904</b>	<b>1.78</b>	<b>0</b>	<b>0.00</b>	<b>-91,264</b>	<b>15.92</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Duct Heat Pkup</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Reheat at Design</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0</b>	<b>0.00</b>			
<b>Grand Total ==&gt;</b>	<b>493,187</b>	<b>34,953</b>	<b>948,724</b>	<b>100.00</b>	<b>478,698</b>	<b>100.00</b>	<b>-118,061</b>	<b>100.00</b>	<b>-573,094</b>	<b>100.00</b>				

AIRFLOWS		
	Cooling	Heating
Vent	6,851	3,173
Infil	0	0
Supply	21,581	7,938
MinStop/Rh	7,938	7,938
Return	21,581	7,938
Exhaust	6,851	3,173
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS		
	Cooling	Heating
% OA	31.7	40.0
cfm/ft²	0.51	0.19
ft³/ton	272.97	
ft³/ton	530.49	
Btu/hr-ft²	22.62	-13.67
No. People	396	

COOLING COIL SELECTION										
	Total Capacity		Sens Cap.	Coil Airflow	Enter DB/WB/HR			Leave DB/WB/HR		
	ton	MBh			°F	°F	gr/lb	°F	°F	gr/lb
Main Clg	79.1	948.7	629.7	19,016	81.6	67.1	77.1	51.8	50.6	53.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>79.1</b>	<b>948.7</b>								

AREAS			
	Gross Total	Glass	(%)
Floor	41,941		
Part	0		
ExFlr	0		
Roof	21,873	0	0
Wall	7,824	5,010	64

HEATING COIL SELECTION				
	Capacity	Coil Airflow	Ent	Lvg
	MBh	cfm	°F	°F
Main Htg	-278.6	7,938	51.8	83.5
Aux Htg	0.0	0	0.0	0.0
Preheat	-294.8	6,851	13.0	51.8
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
<b>Total</b>	<b>-573.4</b>			

# System Checksums

By ae

AHU-2 (South Offices)

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK					CLG SPACE PEAK					HEATING COIL PEAK					TEMPERATURES		
Peaked at Time:		Mo/Hr: 7 / 15			Mo/Hr: 9 / 10		Mo/Hr: 13 / 1			Cooling		Heating					
Outside Air:		OADB/WB/HR: 91 / 77 / 118			OADB: 72		OADB: 13			SADB		Plenum		Return			
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total (%)	Space Sensible	Percent Of Total (%)	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total (%)	Space Sens	Coil Peak Tot Sens	Percent Of Total (%)	Ret/OA	Fn MtrTD	Fn BldTD	Fn Frict		
Btu/h	Btu/h	Btu/h		Btu/h		Btu/h	Btu/h		Btu/h	Btu/h							
<b>Envelope Loads</b>																	
Skylite Solar	0	0	0.00	0	0.00	Skylite Solar	0	0.00	Skylite Solar	0	0.00						
Skylite Cond	0	0	0.00	0	0.00	Skylite Cond	0	0.00	Skylite Cond	0	0.00						
Roof Cond	0	5,429	0.61	0	0.00	Roof Cond	0	2.60	Roof Cond	-12,533	2.60						
Glass Solar	54,619	0	6.19	97,021	29.09	Glass Solar	0	0.00	Glass Solar	0	0.00						
Glass Cond	9,763	0	1.11	-1,953	-0.59	Glass Cond	-35,640	7.40	Glass Cond	-35,640	7.40						
Wall Cond	336	1,329	0.19	206	0.06	Wall Cond	-1,332	1.37	Wall Cond	-6,585	1.37						
Partition	0	0	0.00	0	0.00	Partition	0	0.00	Partition	0	0.00						
Exposed Floor	0	0	0.00	0	0.00	Exposed Floor	0	0.00	Exposed Floor	0	0.00						
Infiltration	0	0	0.00	0	0.00	Infiltration	-5	0.00	Infiltration	-5	0.00						
<b>Sub Total ==&gt;</b>	<b>64,718</b>	<b>6,758</b>	<b>8.09</b>	<b>95,275</b>	<b>28.57</b>	<b>Sub Total ==&gt;</b>	<b>-36,977</b>	<b>11.37</b>	<b>Sub Total ==&gt;</b>	<b>-54,763</b>	<b>11.37</b>						
<b>Internal Loads</b>																	
Lights	111,044	27,761	15.72	111,044	33.30	Lights	0	0.00	Lights	0	0.00						
People	186,000	0	21.06	104,700	31.39	People	0	0.00	People	0	0.00						
Misc	10,312	0	1.17	10,312	3.09	Misc	0	0.00	Misc	0	0.00						
<b>Sub Total ==&gt;</b>	<b>307,356</b>	<b>27,761</b>	<b>37.95</b>	<b>226,056</b>	<b>67.78</b>	<b>Sub Total ==&gt;</b>	<b>0</b>	<b>0.00</b>	<b>Sub Total ==&gt;</b>	<b>0</b>	<b>0.00</b>						
<b>Ceiling Load</b>																	
Lights	14,526	-14,526	0.00	11,041	3.31	Lights	-11,371	0.00	Lights	0	0.00						
Ventilation Load	0	0	49.00	0	0.00	Ventilation Load	0	55.98	Ventilation Load	-269,713	55.98						
Ov/Undr Sizing	0	0	0.00	1,143	0.34	Ov/Undr Sizing	0	0.00	Ov/Undr Sizing	0	0.00						
Exhaust Heat		-17,418	-1.97			Exhaust Heat		-1.01	Exhaust Heat	4,859	-1.01						
Sup. Fan Heat			5.54			OA Preheat Diff.		28.26	OA Preheat Diff.	-136,175	28.26						
Ret. Fan Heat		12,235	1.39			RA Preheat Diff.		5.40	RA Preheat Diff.	-26,032	5.40						
Duct Heat Pkup		0	0.00			Additional Reheat		0.00	Additional Reheat	0	0.00						
Reheat at Design		0	0.00														
<b>Grand Total ==&gt;</b>	<b>386,600</b>	<b>14,810</b>	<b>100.00</b>	<b>333,516</b>	<b>100.00</b>	<b>Grand Total ==&gt;</b>	<b>-48,348</b>	<b>100.00</b>	<b>Grand Total ==&gt;</b>	<b>-481,824</b>	<b>100.00</b>						

COOLING COIL SELECTION										AREAS			HEATING COIL SELECTION							
Total Capacity	Sens Cap.	Coil Airflow	Enter DB/WB/HR	Leave DB/WB/HR	Gross Total	Glass	Capacity	Coil Airflow	Ent	Lvg										
ton	MBh	cfm	°F °F gr/lb	°F °F gr/lb		ft² (%)	MBh	cfm	°F	°F										
Main Clg	73.6	883.1	500.9	13,764	84.6	70.7	91.6	51.8	50.4	52.4	Main Htg	-162.1	5,633	51.8	77.7					
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Aux Htg	0.0	0	0.0	0.0					
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Preheat	-319.7	7,432	13.0	51.8					
<b>Total</b>	<b>73.6</b>	<b>883.1</b>									Humidif	0.0	0	0.0	0.0					
											Opt Vent	0.0	0	0.0	0.0					
											<b>Total</b>	<b>-481.8</b>								

# System Checksums

By ae

AHU-3 (Private Dining & Catering)

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK					CLG SPACE PEAK					HEATING COIL PEAK					TEMPERATURES		
Peaked at Time:		Mo/Hr: 7 / 11			Mo/Hr: 9 / 10		Mo/Hr: 13 / 1			Cooling		Heating					
Outside Air:		OADB/WB/HR: 84 / 74 / 111			OADB: 72		OADB: 13			SADB		89.9					
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total (%)	Space Sensible	Percent Of Total (%)	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total (%)				SADB					
Btu/h	Btu/h	Btu/h		Btu/h		Btu/h	Btu/h					Plenum					
<b>Envelope Loads</b>																	
Skylite Solar	0	0	0.00	0	0.00	0	0	0.00	Skylite Solar	0	0	0.00	Return				
Skylite Cond	0	0	0.00	0	0.00	0	0	0.00	Skylite Cond	0	0	0.00	Ret/OA				
Roof Cond	0	1,767	0.64	0	0.00	0	-10,249	5.71	Roof Cond	0	-10,249	5.71	Fn MtrTD				
Glass Solar	75,980	0	27.33	101,683	67.65	0	0	0.00	Glass Solar	0	0	0.00	Fn BldTD				
Glass Cond	5,534	0	1.99	-1,990	-1.32	0	-36,316	20.25	Glass Cond	-36,316	-36,316	20.25	Fn Frict				
Wall Cond	3,361	2,125	1.97	3,016	2.01	0	-5,230	4.63	Wall Cond	-5,230	-8,302	4.63					
Partition	0	0	0.00	0	0.00	0	0	0.00	Partition	0	0	0.00					
Exposed Floor	0	0	0.00	0	0.00	0	0	0.00	Exposed Floor	0	0	0.00					
Infiltration	0	0	0.00	0	0.00	0	-1	0.00	Infiltration	-1	-1	0.00					
<b>Sub Total ==&gt;</b>	<b>84,875</b>	<b>3,892</b>	<b>31.93</b>	<b>102,709</b>	<b>68.33</b>	<b>-41,547</b>	<b>-54,867</b>	<b>30.59</b>	<b>Sub Total ==&gt;</b>	<b>-41,547</b>	<b>-54,867</b>	<b>30.59</b>					
<b>Internal Loads</b>																	
Lights	18,146	4,537	8.16	18,146	12.07	0	0	0.00	Lights	0	0	0.00					
People	56,800	0	20.43	28,500	18.96	0	0	0.00	People	0	0	0.00					
Misc	0	0	0.00	0	0.00	0	0	0.00	Misc	0	0	0.00					
<b>Sub Total ==&gt;</b>	<b>74,946</b>	<b>4,537</b>	<b>28.59</b>	<b>46,646</b>	<b>31.03</b>	<b>0</b>	<b>0</b>	<b>0.00</b>	<b>Sub Total ==&gt;</b>	<b>0</b>	<b>0</b>	<b>0.00</b>					
<b>Ceiling Load</b>																	
Lights	1,655	-1,655	0.00	959	0.64	-5,370	0	0.00	Lights	0	0	0.00					
Ventilation Load	0	0	33.97	0	0.00	0	-51,048	28.46	Ventilation Load	0	-51,048	28.46					
Ov/Undr Sizing	0	0	0.00	0	0.00	0	0	0.00	Ov/Undr Sizing	0	0	0.00					
Exhaust Heat		-4,241	-1.53				3,015	-1.68	Exhaust Heat		3,015	-1.68					
Sup. Fan Heat			5.12				-56,256	31.37	OA Preheat Diff.		-56,256	31.37					
Ret. Fan Heat		5,337	1.92				-20,189	11.26	RA Preheat Diff.		-20,189	11.26					
Duct Heat Pkup		0	0.00				0	0.00	Additional Reheat		0	0.00					
Reheat at Design		0	0.00														
<b>Grand Total ==&gt;</b>	<b>161,475</b>	<b>7,869</b>	<b>100.00</b>	<b>150,313</b>	<b>100.00</b>	<b>-46,917</b>	<b>-179,345</b>	<b>100.00</b>	<b>Grand Total ==&gt;</b>	<b>-46,917</b>	<b>-179,345</b>	<b>100.00</b>					

TEMPERATURES		
	Cooling	Heating
SADB	55.0	89.9
Plenum	76.0	66.6
Return	76.8	66.6
Ret/OA	79.3	46.3
Fn MtrTD	0.2	0.0
Fn BldTD	0.5	0.0
Fn Frict	1.4	0.0

AIRFLOWS		
	Cooling	Heating
Vent	2,080	808
Infil	0	0
Supply	6,777	2,129
MinStop/Rh	2,129	2,129
Return	6,777	2,129
Exhaust	2,080	808
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS		
	Cooling	Heating
% OA	30.7	37.9
cfm/ft²	1.35	0.42
cfm/ton	292.49	
ft³/ton	217.32	
Btu/hr-ft²	55.22	-35.62
No. People	104	

COOLING COIL SELECTION										
	Total Capacity		Sens Cap.	Coil Airflow	Enter DB/WB/HR			Leave DB/WB/HR		
	ton	MBh			°F	°F	gr/lb	°F	°F	gr/lb
Main Clg	23.2	278.0	175.8	6,004	79.3	66.4	77.3	52.9	51.1	53.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>23.2</b>	<b>278.0</b>								

AREAS			
	Gross Total	Glass	
		ft²	(%)
Floor	5,035		
Part	0		
ExFlr	0		
Roof	5,035	0	0
Wall	3,786	2,144	57

HEATING COIL SELECTION				
	Capacity	Coil Airflow	Ent	Lvg
Main Htg	-87.4	2,129	52.9	89.9
Aux Htg	0.0	0	0.0	0.0
Preheat	-92.0	2,080	13.0	52.9
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
<b>Total</b>	<b>-179.4</b>			

# System Checksums

By ae

AHU-4 (Bookstore)

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK					CLG SPACE PEAK					HEATING COIL PEAK					TEMPERATURES		
Peaked at Time:		Mo/Hr: 7 / 8			Mo/Hr: 7 / 9		Mo/Hr: 13 / 1			Cooling		Heating					
Outside Air:		OADB/WB/HR: 76 / 72 / 111			OADB: 78		OADB: 13			SADB		86.6					
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total (%)	Space Sensible	Percent Of Total (%)	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total (%)	Return	Ret/OA	Fn MtrTD	Fn BldTD	Fn Frict				
Btu/h	Btu/h	Btu/h		Btu/h		Btu/h	Btu/h										
<b>Envelope Loads</b>																	
Skylite Solar	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
Skylite Cond	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
Roof Cond	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
Glass Solar	121,697	0	36.26	121,257	66.27	0	0	0.00	0	0	0.00	0	0	0.00			
Glass Cond	291	0	0.09	1,304	0.71	-24,649	-24,649	11.98	0	0	0.00	0	0	0.00			
Wall Cond	303	368	0.20	270	0.15	-1,841	-3,910	1.90	0	0	0.00	0	0	0.00			
Partition	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
Exposed Floor	1,878	0	0.56	1,686	0.92	-18,603	-18,603	9.04	0	0	0.00	0	0	0.00			
Infiltration	0	0	0.00	0	0.00	-1	-1	0.00	0	0	0.00	0	0	0.00			
<b>Sub Total ==&gt;</b>	<b>124,170</b>	<b>368</b>	<b>37.10</b>	<b>124,517</b>	<b>68.05</b>	<b>-45,093</b>	<b>-47,163</b>	<b>22.92</b>									
<b>Internal Loads</b>																	
Lights	21,166	5,292	7.88	21,166	11.57	0	0	0.00	0	0	0.00	0	0	0.00			
People	69,440	0	20.69	35,217	19.25	0	0	0.00	0	0	0.00	0	0	0.00			
Misc	924	0	0.28	924	0.51	0	0	0.00	0	0	0.00	0	0	0.00			
<b>Sub Total ==&gt;</b>	<b>91,530</b>	<b>5,292</b>	<b>28.85</b>	<b>57,307</b>	<b>31.32</b>	<b>0</b>	<b>0</b>	<b>0.00</b>									
<b>Ceiling Load</b>																	
Lights	1,164	-1,164	0.00	1,155	0.63	-836	0	0.00	0	0	0.00	0	0	0.00			
Ventilation Load	0	0	26.82	0	0.00	0	-148,309	72.08	0	0	0.00	0	0	0.00			
Ov/Undr Sizing	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
Exhaust Heat	0	-3,647	-1.09	0	0.00	0	1,207	-0.59	0	0	0.00	0	0	0.00			
Sup. Fan Heat	0	0	6.13	20,591	11.17	0	-8,548	4.15	0	0	0.00	0	0	0.00			
Ret. Fan Heat	0	7,319	2.18	7,319	3.91	0	-2,944	1.43	0	0	0.00	0	0	0.00			
Duct Heat Pkup	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
Reheat at Design	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00			
<b>Grand Total ==&gt;</b>	<b>216,865</b>	<b>8,167</b>	<b>100.00</b>	<b>182,979</b>	<b>100.00</b>	<b>-45,929</b>	<b>-205,757</b>	<b>100.00</b>									

COOLING COIL SELECTION										AREAS			HEATING COIL SELECTION				
Total Capacity	Sens Cap.	Coil Airflow	Enter DB/WB/HR	Leave DB/WB/HR	Gross Total	Glass	Capacity	Coil Airflow	Ent	Lvg							
ton	MBh	MBh	°F °F gr/lb	°F °F gr/lb		ft² (%)	MBh	cfm	°F	°F							
Main Clg	28.0	335.7	213.3	8,234	76.1	65.3	76.9	52.8	51.7	55.8	Floor	7,451					
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	Part	0					
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	ExFlr	3,596					
<b>Total</b>	<b>28.0</b>	<b>335.7</b>									Roof	0	0	0			
											Wall	2,250	1,455	65			
											Main Htg	-94.0	2,504	52.8	86.6		
											Aux Htg	0.0	0	0.0	0.0		
											Preheat	-112.0	2,540	13.0	52.8		
											Humidif	0.0	0	0.0	0.0		
											Opt Vent	0.0	0	0.0	0.0		
											<b>Total</b>	<b>-206.0</b>					

# System Checksums

By ae

AHU-5 (Dining Hall Seating & Service)

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK					CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES					
Peaked at Time:		Mo/Hr: 7 / 15			Mo/Hr: 6 / 18		Mo/Hr: 13 / 1						Cooling		Heating			
Outside Air:		OADB/WB/HR: 91 / 77 / 118			OADB: 84		OADB: 84											
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total	Space Sensible	Percent Of Total	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total	Space Sens	Coil Peak Tot Sens	Percent Of Total	SADB	Plenum	Return	Ret/OA	Fn MtrTD	Fn BldTD	Fn Frict
Btu/h	Btu/h	Btu/h	(%)	Btu/h	(%)	Btu/h	Btu/h	(%)	Btu/h	Btu/h	(%)							
<b>Envelope Loads</b>					<b>Envelope Loads</b>				<b>Envelope Loads</b>									
Skylite Solar	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	55.0	78.8					
Skylite Cond	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	75.5	69.8					
Roof Cond	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	76.5	69.8					
Glass Solar	29,543	0	3.46	36,976	16.18	0	0	0.00	0	0	0.00	91.0	13.9					
Glass Cond	9,116	0	1.07	5,014	2.19	-33,277	-33,277	5.98	0	0	0.00	0.2	0.0					
Wall Cond	180	194	0.04	127	0.06	-906	-1,925	0.35	0	0	0.00	0.5	0.0					
Partition	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00	1.5	0.0					
Exposed Floor	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00							
Infiltration	0	0	0.00	0	0.00	-1	-1	0.00	0	0	0.00							
<b>Sub Total ==&gt;</b>	<b>38,838</b>	<b>194</b>	<b>4.57</b>	<b>42,117</b>	<b>18.43</b>	<b>-34,183</b>	<b>-35,202</b>	<b>6.33</b>	<b>0</b>	<b>0</b>	<b>0.00</b>							
<b>Internal Loads</b>					<b>Internal Loads</b>				<b>Internal Loads</b>									
Lights	24,183	6,046	3.54	24,183	10.58	0	0	0.00	0	0	0.00							
People	322,850	0	37.82	161,425	70.65	0	0	0.00	0	0	0.00							
Misc	0	0	0.00	0	0.00	0	0	0.00	0	0	0.00							
<b>Sub Total ==&gt;</b>	<b>347,033</b>	<b>6,046</b>	<b>41.36</b>	<b>185,608</b>	<b>81.23</b>	<b>0</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0</b>	<b>0.00</b>							
<b>Ceiling Load</b>	531	-531	0.00	499	0.22	-186	0	0.00										
<b>Ventilation Load</b>	0	0	51.82	0	0.00	0	-222,646	40.02										
<b>Ov/Undr Sizing</b>	268	0	0.03	268	0.12	0	0	0.00										
<b>Exhaust Heat</b>		-16,395	-1.92				820	-0.15										
<b>Sup. Fan Heat</b>			2.89				-299,249	53.79										
<b>Ret. Fan Heat</b>		10,650	1.25				0	0.00										
<b>Duct Heat Pkup</b>		0	0.00				0	0.00										
<b>Reheat at Design</b>		0	0.00				0	0.00										
<b>Grand Total ==&gt;</b>	<b>386,671</b>	<b>-36</b>	<b>853,626</b>	<b>100.00</b>	<b>228,493</b>	<b>100.00</b>	<b>-34,369</b>	<b>-556,278</b>	<b>100.00</b>	<b>-34,369</b>	<b>-556,278</b>							

COOLING COIL SELECTION										AREAS			HEATING COIL SELECTION				
Total Capacity	Sens Cap.	Coil Airflow	Enter DB/WB/HR	Leave DB/WB/HR	Gross Total	Glass	Capacity	Coil Airflow	Ent	Lvg							
ton	MBh	MBh	°F °F gr/lb	°F °F gr/lb		ft² (%)	MBh	cfm	°F	°F							
<b>Main Clg</b>	71.1	853.6	430.1	10,153	91.0	76.9	118.3	52.8	52.8	59.7	<b>Main Htg</b>	-103.1	3,580	52.8	78.8		
<b>Aux Clg</b>	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	<b>Aux Htg</b>	0.0	0	0.0	0.0		
<b>Opt Vent</b>	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	<b>Preheat</b>	-454.8	10,300	13.0	52.8		
<b>Total</b>	<b>71.1</b>	<b>853.6</b>									<b>Humidif</b>	0.0	0	0.0	0.0		
											<b>Opt Vent</b>	0.0	0	0.0	0.0		
											<b>Total</b>	<b>-557.8</b>					

# System Checksums

By ae

AHU-6 (Kitchen)

Incremental Heat Pump

COOLING COIL PEAK					CLG SPACE PEAK				HEATING COIL PEAK				TEMPERATURES		
Peaked at Time:		Mo/Hr: 7 / 15			Mo/Hr: 3 / 12		Mo/Hr: 13 / 1					Cooling Heating			
Outside Air:		OADB/WB/HR: 91 / 77 / 118			OADB: 55		OADB: 13					SADB	55.0	70.0	
Space Sens.	Plenum Sens.	Net Total	Percent Of Total	Space Sensible	Percent Of Total	Space Peak	Coil Peak	Percent	Space Sens	Tot Sens	Of Total	Ret/OA	Fn MtrTD	Fn BldTD	Fn Frict
Btu/h	Btu/h	Btu/h	(%)	Btu/h	(%)	Btu/h	Btu/h	(%)	Btu/h	Btu/h	(%)				
<b>Envelope Loads</b>					<b>Envelope Loads</b>				<b>Envelope Loads</b>						
Skylite Solar	0	0	0.00	0	0.00	Skylite Solar	0	0.00	0	0	0.00	Skylite Solar	0	0	0.0
Skylite Cond	0	0	0.00	0	0.00	Skylite Cond	0	0.00	0	0	0.00	Skylite Cond	0	0	0.0
Roof Cond	0	0	0.00	0	0.00	Roof Cond	0	0.00	0	0	0.00	Roof Cond	0	0	0.0
Glass Solar	0	0	0.00	0	0.00	Glass Solar	0	0.00	0	0	0.00	Glass Solar	0	0	0.0
Glass Cond	0	0	0.00	0	0.00	Glass Cond	0	0.00	0	0	0.00	Glass Cond	0	0	0.0
Wall Cond	0	0	0.00	0	0.00	Wall Cond	0	0.00	0	0	0.00	Wall Cond	0	0	0.0
Partition	0	0	0.00	0	0.00	Partition	0	0.00	0	0	0.00	Partition	0	0	0.0
Exposed Floor	0	0	0.00	0	0.00	Exposed Floor	0	0.00	0	0	0.00	Exposed Floor	0	0	0.0
Infiltration	0	0	0.00	0	0.00	Infiltration	0	0.01	0	0	0.01	Infiltration	0	0	0.01
<i>Sub Total ==&gt;</i>	0	0	0.00	0	0.00	<i>Sub Total ==&gt;</i>	0	0.01	0	0	0.01	<i>Sub Total ==&gt;</i>	0	0	0.01
<b>Internal Loads</b>					<b>Internal Loads</b>				<b>Internal Loads</b>						
Lights	5,242	1,310	6,552	0.45	5,242	0.38	Lights	0	0	0.00	Lights	0	0	0	0.00
People	3,650		3,650	0.25	1,875	0.14	People	0	0	0.00	People	0	0	0	0.00
Misc	1,353,868	0	1,353,868	93.54	1,353,868	99.33	Misc	0	0	0.00	Misc	0	0	0	0.00
<i>Sub Total ==&gt;</i>	1,362,759	1,310	1,364,070	94.24	1,360,984	99.85	<i>Sub Total ==&gt;</i>	0	0	0.00	<i>Sub Total ==&gt;</i>	0	0	0	0.00
<b>Ceiling Load</b>	2,038	-2,038	0	0.00	2,048	0.15	<b>Ceiling Load</b>	0	0	0.00	<b>Ceiling Load</b>	0	0	0	0.00
<b>Ventilation Load</b>	0	0	2,090	0.14	0	0.00	<b>Ventilation Load</b>	0	-2,529	100.00	<b>Ventilation Load</b>	0	-2,529	100.00	
<b>Ov/Undr Sizing</b>	0		0	0.00	0	0.00	<b>Ov/Undr Sizing</b>	0	0	-0.02	<b>Ov/Undr Sizing</b>	0	0	-0.02	
<b>Exhaust Heat</b>		-441	-441	-0.03			<b>Exhaust Heat</b>		0	0.00	<b>Exhaust Heat</b>		0	0	0.00
<b>Sup. Fan Heat</b>			81,716	5.65			<b>Sup. Fan Heat</b>		0	0.00	<b>Sup. Fan Heat</b>		0	0	0.00
<b>Ret. Fan Heat</b>		0	0	0.00			<b>Ret. Fan Heat</b>		0	0.01	<b>Ret. Fan Heat</b>		0	0	0.01
<b>Duct Heat Pkup</b>		0	0	0.00			<b>Duct Heat Pkup</b>		0	0.00	<b>Duct Heat Pkup</b>		0	0	0.00
<b>Reheat at Design</b>			0	0.00			<b>Reheat at Design</b>				<b>Reheat at Design</b>				
<b>Grand Total ==&gt;</b>	1,364,797	-1,168	1,447,436	100.00	1,363,033	100.00	<b>Grand Total ==&gt;</b>	0	-2,529	100.00	<b>Grand Total ==&gt;</b>	0	-2,529	100.00	

COOLING COIL SELECTION										AREAS			HEATING COIL SELECTION				
Total Capacity	Sens Cap.	Coil Airflow	Enter DB/WB/HR	Leave DB/WB/HR	Gross Total		Glass		Capacity	Coil Airflow	Ent	Lvg					
ton	MBh	cfm	°F °F gr/lb	°F °F gr/lb	ft²	ft² (%)	MBh	cfm	°F	°F	°F	°F					
<b>Main Clg</b>	120.6	1,447.4	1,444.3	41,040	85.5 59.5 34.9	53.8 46.1 34.3	<b>Floor</b>	1,700		-2.5	41,040	69.9	70.0				
<b>Aux Clg</b>	0.0	0.0	0.0	0	0.0 0.0 0.0	0.0 0.0 0.0	<b>Part</b>	0		0.0	0	0.0	0.0				
<b>Opt Vent</b>	0.0	0.0	0.0	0	0.0 0.0 0.0	0.0 0.0 0.0	<b>ExFlr</b>	0		0.0	0	0.0	0.0				
<b>Total</b>	120.6	1,447.4					<b>Roof</b>	0	0	0.0	0	0.0	0.0				
							<b>Wall</b>	0	0	0	0	0.0	0.0				
										0.0	0	0.0	0.0				
										0.0	0	0.0	0.0				
										-2.5							

# System Checksums

By ae

WSHPs (AHU-1,4 N-WING)

Water Source Heat Pump

COOLING COIL PEAK					CLG SPACE PEAK					HEATING COIL PEAK					TEMPERATURES		
Peaked at Time:		Mo/Hr: 7 / 9			Mo/Hr: 7 / 9		Mo/Hr: 13 / 1			Cooling		Heating					
Outside Air:		OADB/WB/HR: 78 / 72 / 107			OADB: 78		OADB: 13										
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total	Space Sensible	Percent Of Total	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total	SADB	Plenum	Return	Ret/OA	Fn MtrTD	Fn BldTD	Fn Frict		
Btu/h	Btu/h	Btu/h	(%)	Btu/h	(%)	Btu/h	Btu/h	(%)									
<b>Envelope Loads</b>					<b>Envelope Loads</b>												
Skylite Solar	0	0	0.00	0	0.00	Skylite Solar	0	0.00									
Skylite Cond	0	0	0.00	0	0.00	Skylite Cond	0	0.00									
Roof Cond	0	28,175	2.52	0	0.00	Roof Cond	0	-46,548	6.01								
Glass Solar	376,935	0	33.69	391,827	51.61	Glass Solar	0	0.00									
Glass Cond	10,085	0	0.90	6,513	0.86	Glass Cond	-107,954	13.94									
Wall Cond	2,139	3,348	0.49	1,993	0.26	Wall Cond	-5,092	1.89									
Partition	0	0	0.00	0	0.00	Partition	0	0.00									
Exposed Floor	1,878	0	0.17	1,686	0.22	Exposed Floor	-18,603	2.40									
Infiltration	2	0	0.00	2	0.00	Infiltration	-8	0.00									
<b>Sub Total ==&gt;</b>	<b>391,039</b>	<b>31,523</b>	<b>37.77</b>	<b>402,021</b>	<b>52.95</b>	<b>Sub Total ==&gt;</b>	<b>-131,657</b>	<b>24.24</b>									
<b>Internal Loads</b>					<b>Internal Loads</b>												
Lights	149,485	37,371	16.70	149,485	19.69	Lights	0	0.00									
People	238,852	0	21.35	133,248	17.55	People	0	0.00									
Misc	51,267	0	4.58	51,267	6.75	Misc	0	0.00									
<b>Sub Total ==&gt;</b>	<b>439,603</b>	<b>37,371</b>	<b>42.63</b>	<b>333,999</b>	<b>43.99</b>	<b>Sub Total ==&gt;</b>	<b>0</b>	<b>0.00</b>									
<b>Ceiling Load</b>	<b>20,337</b>	<b>-20,337</b>	<b>0.00</b>	<b>23,210</b>	<b>3.06</b>	<b>Ceiling Load</b>	<b>-14,020</b>	<b>0.00</b>									
<b>Ventilation Load</b>	<b>0</b>	<b>0</b>	<b>19.73</b>	<b>0</b>	<b>0.00</b>	<b>Ventilation Load</b>	<b>0</b>	<b>16.48</b>									
<b>Ov/Undr Sizing</b>	<b>0</b>	<b>0</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>Ov/Undr Sizing</b>	<b>-357</b>	<b>0.05</b>									
<b>Exhaust Heat</b>		<b>-13,694</b>	<b>-1.22</b>			<b>Exhaust Heat</b>		<b>-1.02</b>									
<b>Sup. Fan Heat</b>			<b>1.09</b>			<b>OA Preheat Diff.</b>		<b>57.50</b>									
<b>Ret. Fan Heat</b>			<b>0.00</b>			<b>RA Preheat Diff.</b>		<b>2.75</b>									
<b>Duct Heat Pkup</b>			<b>0.00</b>			<b>Additional Reheat</b>		<b>0.00</b>									
<b>Reheat at Design</b>			<b>0.00</b>														
<b>Grand Total ==&gt;</b>	<b>850,979</b>	<b>34,863</b>	<b>1,118,773</b>	<b>100.00</b>	<b>759,231</b>	<b>100.00</b>	<b>Grand Total ==&gt;</b>	<b>-146,034</b>	<b>-774,531</b>	<b>100.00</b>							

AIRFLOWS		
	Cooling	Heating
<b>Vent</b>	9,429	8,528
<b>Infil</b>	0	0
<b>Supply</b>	41,276	41,276
<b>MinStop/Rh</b>	0	0
<b>Return</b>	41,276	41,276
<b>Exhaust</b>	9,429	8,528
<b>Rm Exh</b>	0	0
<b>Auxiliary</b>	0	0

ENGINEERING CKS		
	Cooling	Heating
<b>% OA</b>	22.8	20.7
<b>cfm/ft²</b>	0.82	0.82
<b>cfm/ton</b>	367.98	
<b>ft³/ton</b>	447.87	
<b>Btu/hr-ft²</b>	26.79	-12.80
<b>No. People</b>	525	

COOLING COIL SELECTION										
	Total Capacity		Sens Cap.	Coil Airflow	Enter DB/WB/HR			Leave DB/WB/HR		
	ton	MBh			°F	°F	gr/lb	°F	°F	gr/lb
<b>Main Clg</b>	93.2	1,118.8	768.4	41,276	76.1	64.8	74.2	58.2	56.0	63.9
<b>Aux Clg</b>	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Opt Vent</b>	18.9	227.2	175.7	9,429	91.3	77.1	118.7	74.5	71.2	110.9
<b>Total</b>	112.2	1,346.0								

AREAS			
	Gross Total	Glass	(%)
<b>Floor</b>	50,237		
<b>Part</b>	0		
<b>ExFlr</b>	3,596		
<b>Roof</b>	21,873	0	0
<b>Wall</b>	10,074	6,465	64

HEATING COIL SELECTION					
	Capacity	Coil Airflow	Ent	Lvg	
	MBh	cfm	°F	°F	
<b>Main Htg</b>	-203.8	41,276	65.9	70.3	
<b>Aux Htg</b>	-145.7	0	0.0	0.0	
<b>Preheat</b>	0.0	0	0.0	0.0	
<b>Humidif</b>	0.0	0	0.0	0.0	
<b>Opt Vent</b>	-439.2	9,429	13.0	55.0	
<b>Total</b>	-788.7				

# System Checksums

By ae

WSHPs (AHU-2,3,5,6 S-WING)

Water Source Heat Pump

COOLING COIL PEAK					CLG SPACE PEAK					HEATING COIL PEAK					TEMPERATURES																																																																				
Peaked at Time:		Mo/Hr: 7 / 15			Mo/Hr: 9 / 10		Mo/Hr: 13 / 1																																																																												
Outside Air:		OADB/WB/HR: 91 / 77 / 118			OADB: 72		OADB: 13																																																																												
Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total (%)	Space Sensible	Percent Of Total (%)	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total (%)																																																																											
Btu/h	Btu/h	Btu/h		Btu/h		Btu/h	Btu/h																																																																												
<b>Envelope Loads</b>					<b>Envelope Loads</b>					<b>Envelope Loads</b>																																																																									
Skylite Solar	0	0	0.00	0	0.00	0	0	0.00	Skylite Solar	0	0	0.00	SADB	56.9	71.2	Plenum	79.5	69.7	Return	79.5	69.7	Ret/OA	78.4	66.1	Fn MtrTD	0.0	0.0	Fn BldTD	0.1	0.0	Fn Frict	0.2	0.0																																																		
Skylite Cond	0	0	0.00	0	0.00	0	0	0.00	Skylite Cond	0	0	0.00	Roof Cond	0	-23,531	1.59	Roof Cond	0	0	0.00	Glass Solar	241,552	0	8.52	Glass Solar	0	0	0.00	Glass Cond	16,783	0	0.59	Glass Cond	-105,232	-105,232	7.09	Wall Cond	4,587	3,861	0.30	Wall Cond	-7,468	-17,055	1.15	Partition	0	0	0.00	Partition	0	0	0.00	Exposed Floor	0	0	0.00	Exposed Floor	0	0	0.00	Infiltration	2	2	0.00	Infiltration	-7	-7	0.00	Sub Total ==>	262,924	13,461	9.75	Sub Total ==>	-112,707	-145,825	9.83	Sub Total ==>	297,340	13.46	Sub Total ==>	-112,707	-145,825	9.83
<b>Internal Loads</b>					<b>Internal Loads</b>					<b>Internal Loads</b>																																																																									
Lights	156,955	39,239	6.92	156,955	7.11	0	0	0.00	Lights	0	0	0.00	People	569,300	569,300	20.08	People	0	0	0.00	Misc	1,388,242	0	48.97	Misc	0	0	0.00	Sub Total ==>	2,114,496	39,239	75.97	Sub Total ==>	1,841,696	83.39	Sub Total ==>	0	0	0.00																																												
<b>Ceiling Load</b>					<b>Ceiling Load</b>					<b>Ceiling Load</b>																																																																									
Ventilation Load	0	0	17.12	0	0.00	0	0	0.00	Ventilation Load	0	-353,773	23.85	Ov/Undr Sizing	0	0	0.00	Ov/Undr Sizing	0	-466	0.03	Exhaust Heat	-106,519	-106,519	-3.76	Exhaust Heat	7,020	-0.47	Sup. Fan Heat	25,853	0.91	OA Preheat Diff.	-990,564	66.77	RA Preheat Diff.	0	0.00	Additional Reheat	0	0.00																																												
Ov/Undr Sizing	0	0	0.00	0	0.00	Exhaust Heat	0	0.00	OA Preheat Diff.	-990,564	66.77	RA Preheat Diff.	0	0.00	Additional Reheat	0	0.00	Grand Total ==>	2,445,709	-122,108	2,834,856	100.00	Grand Total ==>	-117,487	-1,483,607	100.00																																																									

AIRFLOWS		
	Cooling	Heating
Vent	21,266	21,266
Infil	0	0
Supply	87,255	87,255
MinStop/Rh	0	0
Return	87,255	87,255
Exhaust	21,266	21,266
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS		
	Cooling	Heating
% OA	24.4	24.4
cfm/ft²	1.72	1.72
cfm/ton	312.80	
ft²/ton	182.06	
Btu/hr-ft²	65.91	-29.21
No. People	1,120	

COOLING COIL SELECTION										
	Total Capacity		Sens Cap.	Coil Airflow	Enter DB/WB/HR			Leave DB/WB/HR		
	ton	MBh			°F	°F	gr/lb	°F	°F	gr/lb
Main Clg	236.2	2,834.9	2,088.1	87,255	78.5	64.6	69.6	56.7	53.9	57.8
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	42.7	512.5	396.3	21,266	91.3	77.1	118.7	74.5	71.2	110.9
<b>Total</b>	<b>279.0</b>	<b>3,347.4</b>								

AREAS			
	Gross Total	Glass	
		ft²	(%)
Floor	50,786		
Part	0		
ExFlr	0		
Roof	10,935	0	0
Wall	10,607	6,213	59

HEATING COIL SELECTION					
	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F	
Aux Htg	0.0	0	0.0	0.0	
Preheat	0.0	0	0.0	0.0	
Humidif	0.0	0	0.0	0.0	
Opt Vent	-990.6	21,266	13.0	55.0	
<b>Total</b>	<b>-1,483.6</b>				



# SYSTEM SUMMARY

## DESIGN CAPACITY QUANTITIES

By ae

System Description	System Type	COOLING				HEATING						
		Main System Capacity ton	Auxiliary System Capacity ton	Optional Vent Capacity ton	Cooling Totals ton	Main System Capacity Btu/h	Auxiliary System Capacity Btu/h	Preheat Capacity Btu/h	Reheat Capacity Btu/h	Humidification Capacity Btu/h	Optional Vent Capacity Btu/h	Heating Totals Btu/h
AHU-1 (Atrium & North Offices)	Variable Volume Reheat (30% V	79	0	0	79	-278,640	0	-294,780	-160,253	0	0	-573,420
AHU-2 (South Offices)	Variable Volume Reheat (30% V	74	0	0	74	-162,089	0	-319,741	-113,735	0	0	-481,830
AHU-3 (Private Dining & Catering)	Variable Volume Reheat (30% V	23	0	0	23	-87,389	0	-91,956	-40,471	0	0	-179,346
AHU-4 (Bookstore)	Variable Volume Reheat (30% V	28	0	0	28	-93,995	0	-111,962	-47,866	0	0	-205,956
AHU-5 (Dining Hall Seating & Service)	Variable Volume Reheat (30% V	71	0	0	71	-103,085	0	-454,747	-68,246	0	0	-557,832
AHU-6 (Kitchen)	Incremental Heat Pump	121	0	0	121	-2,533	0	0	0	0	0	-2,533
<b>Totals</b>		<b>396</b>	<b>0</b>	<b>0</b>	<b>396</b>	<b>-727,731</b>	<b>0</b>	<b>-1,273,186</b>	<b>-430,571</b>	<b>0</b>	<b>0</b>	<b>-2,000,917</b>

\* The building peaked at hour 15 month 7 with a capacity of 396 tons.

# SYSTEM SUMMARY

## DESIGN CAPACITY QUANTITIES

By ae

System Description	System Type	COOLING				HEATING						
		Main System Capacity ton	Auxiliary System Capacity ton	Optional Vent Capacity ton	Cooling Totals ton	Main System Capacity Btu/h	Auxiliary System Capacity Btu/h	Preheat Capacity Btu/h	Reheat Capacity Btu/h	Humidification Capacity Btu/h	Optional Vent Capacity Btu/h	Heating Totals Btu/h
WSHPs (AHU-1,4 N-WING)	Water Source Heat Pump	93	0	19	112	-203,842	-145,683	0	0	0	-439,212	-788,737
WSHPs (AHU-2,3,5,6 S-WING)	Water Source Heat Pump	236	0	43	279	-493,048	0	0	0	0	-990,564	-1,483,612
Totals		329	0	62	391	-696,890	-145,683	0	0	0	-1,429,776	-2,272,349

\* The building peaked at hour 8 month 7 with a capacity of 382 tons.

FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	OCCUPANCY	DESIGNED SA (cfm)	ASHRAE	ASHRAE	ASHRAE 62.1 2004 Required			1=N WING 2=S WING	NORTH WING OA	SOUTH WING OA
						STD 90.1 Lighting	STD 90.1 Compliant	OA Ventilation					
						W/ft <sup>2</sup>	yes/no	cfm/ person	cfm/ft <sup>2</sup>	Total cfm			
1st	100	ATRIUM / LOWER LOBBY	2,000	15	5500	0.6	NO	5.0	0.06	195	1	195	0
1st	101	FAMILY TOILET	48	0	---	0.9	NO				1	0	0
1st	102	ELEV MACHINE ROOM	100	0	200	1.5	YES	5.0	0.06	6	1	6	0
1st	103	HOUSE KEEPING	100	0	---	0.6	NO	5.0	0.06	6	1	6	0
1st	104	HOUSE KEEPING OFFICE	142	0	100	1.1	YES	5.0	0.06	9	1	9	0
1st	105	MECHANICAL	410	0	---	1.5	YES	5.0	0.06	25	1	25	0
1st	106	STORAGE	1,440	0	300	0.6	NO	0.0	0.12	173	1	173	0
1st	107	OFFICE SUPPORT WORK AREA	1,125	6	450	1.1	NO	5.0	0.06	98	1	98	0
1st	108	RECEPTON	200	1	175	1.1	NO	5.0	0.06	17	1	17	0
1st	109	ASSISTANT OFFICE	140	2	550	1.1	NO	5.0	0.06	18	1	18	0
1st	110	MANAGER OFFICE	140	2	550	1.1	NO	5.0	0.06	18	1	18	0
1st	111	DIRECTOR OFFICE	150	2	660	1.1	NO	5.0	0.06	19	1	19	0
1st	112	CASH HANDLING WORK ROOM	250	4	260	1.5	YES	5.0	0.06	35	1	35	0
1st	112A	CLOSET	20	0	---	0.3	YES	5.0	0.06	1	1	1	0
1st	113	BOOKSTORE MERCHANDISING AREA	3,596	110	6360	1.7	YES	7.5	0.12	1257	1	1257	0
1st	114	WELCOME CENTER RECEPTION	230	6	428	1.3	NO	5.0	0.06	44	1	44	0
1st	115	CALL CENTER	100	1	75	1.1	NO	5.0	0.06	11	1	11	0
1st	116	SHARED OFFICE	595	6	400	1.1	NO	5.0	0.06	66	1	66	0
1st	116A	OFFICE STORAGE	100	0	50	0.8	NO	0.0	0.12	12	1	12	0
1st	117	SECURITY RECEPTION	150	2	125	1.1	NO	5.0	0.06	19	1	19	0
1st	118	ID OFFICE	170	2	140	1.1	NO	5.0	0.06	20	1	20	0
1st	119	DIRECTOR OFFICE	150	2	135	1.1	YES	5.0	0.06	19	1	19	0
1st	119A	STORAGE	100	0	105	0.8	NO	5.0	0.12	12	1	12	0
1st	R11	WOMEN TOILET ROOM	350	0	300	0.9	NO	5.0	0.06	21	1	21	0
1st	R12	MEN TOILET ROOM	350	0	300	0.9	NO	5.0	0.06	21	1	21	0
1st	E11	ELECTRICAL CLOSET	40	0	285	1.5	NO	5.0	0.06	2	1	2	0
1st	T11	TELECOM & AV	40	0	---	1.5	NO	5.0	0.06	2	1	2	0
1st	V11	VESTIBULE	190	0	---	0.6	NO	5.0	0.06	11	1	11	0
1st	C11	CORRIDOR	55	0	---	0.5	NO	5.0	0.06	3	1	3	0
1st	C12	CORRIDOR	1,025	0	440	0.5	NO	5.0	0.06	62	1	62	0
1st	C13	CORRIDOR	500	0	315	0.5	NO	5.0	0.06	30	1	30	0
1st	C14	CORRIDOR	545	0	---	0.5	NO	5.0	0.06	33	2	0	33
1st	C15	CORRIDOR	500	0	400	0.5	NO	5.0	0.06	30	2	0	30
1st	C16	CORRIDOR	175	0	---	0.5	NO	5.0	0.06	11	2	0	11
1st	120	MAIN DINING HALL	5730	250	11400	0.9	YES	7.5	0.18	2906	2	0	2906
1st	120A	HOUSE KEEPING CLOSET	37	0	---	0.6	NO	5.0	0.06	2	2	0	2
1st	121	FOOD SERVING AREA	2395	60	3600	1.2	YES	7.5	0.18	881	2	0	881
1st	122	KITCHEN	1045	5	5700	1.2	YES	7.5	0.18	226	2	0	226
1st	123	FOOD SERVICE OFFICE	135	2	150	1.1	NO	5.0	0.06	18	2	0	18
1st	124	DRY STORAGE	520	0	---	0.8	NO	5.0	0.06	31	2	0	31
1st	125	PRIVATE RESTROOM	42	0	---	0.9	NO	5.0	0.06	3	2	0	3
1st	126	HOUSEKEEPING STORAGE	35	0	---	0.8	NO	5.0	0.12	4	2	0	4
1st	127	CATERING STORAGE	250	0	---	0.8	NO	5.0	0.12	30	2	0	30
1st	128	CENTRAL TRASH	140	0	---	0.8	NO	5.0	0.06	8	2	0	8
1st	L11	LOADING DOCK	525	0	---	0.5	YES				2	0	0
1st	T12	TELECOM & AV	50	0	---	1.5	YES	5.0	0.06	3	2	0	3
1st	E12	ELECTRICAL CLOSET	50	0	285	1.5	YES	5.0	0.06	3	2	0	3
			26,180							6421	LR TOTAL	2232	4189
												14"/12X12	18"/16X16
2nd	200	VENDING ALCOVE	100	0	----	0.5	NO	5.0	0.06	6	1	6	0
2nd	200A	JANITORS CLOSET	60	0	----	0.6	NO	5.0	0.06	4	1	4	0
2nd	201	FINANCE RECEPTION	300	5	350	1.1	NO	5.0	0.06	43	1	43	0
2nd	C201	CORRIDOR	1450	0	1950	0.5	YES	5.0	0.06	87	1	87	0
2nd	202	OFFICE SUPPORT WORK AREA	495	5	700	1.1	NO	5.0	0.06	55	1	55	0
2nd	C202N	CORRIDOR	110	0	----	0.5	NO	5.0	0.06	7	1	7	0
2nd	203	AR/CR OFFICE 2	135	1	620	1.1	YES	5.0	0.06	13	1	13	0
2nd	C203	CORRIDOR	480	0	----	0.5	YES	5.0	0.06	29	1	29	0
2nd	204	AR/CR OFFICE 1	135	1	470	1.1	YES	5.0	0.06	13	1	13	0
2nd	C204	CORRIDOR	545	0	200	0.5	NO	5.0	0.06	33	1	33	0
2nd	205	ASSOCIATE DIRECTOR 1	135	2	620	1.1	YES	5.0	0.06	18	1	18	0
2nd	C205	CORRIDOR	210	0	----	0.5	NO	5.0	0.06	13	1	13	0
2nd	206	ADMINISTRATIVE	135	1	620	1.1	YES	5.0	0.06	13	1	13	0
2nd	C206	CORRIDOR	140	0	360	0.5	NO	5.0	0.06	8	1	8	0
2nd	207	SHARED OFFICE ACCOUNTS PAYABLE	415	4	680	1.1	YES	5.0	0.06	45	1	45	0
2nd	208	ASSOCIATE DIRECTOR 2	135	2	150	1.1	YES	5.0	0.06	18	1	18	0
2nd	209	ASSOCIATE DIRECTOR 3	135	2	150	1.1	YES	5.0	0.06	18	1	18	0
2nd	210	ADMIN OFFICE 2	135	2	140	1.1	YES	5.0	0.06	18	1	18	0
2nd	211	SHARED OFFICE PAYROLL	420	4	470	1.1	YES	5.0	0.06	45	1	45	0
2nd	212	CASHIERS	485	4	550	1.5	YES	5.0	0.06	49	1	49	0
2nd	213	SUPERVISOR OFFICE	135	1	135	1.1	YES	5.0	0.06	13	1	13	0
2nd	214	AR/CR SHARED OFFICE	290	2	300	1.1	NO	5.0	0.06	27	1	27	0
2nd	215	STORAGE/ FILE ROOM	400	0	110	0.8	NO	5.0	0.06	24	1	24	0
2nd	216	CASH HANDLING WORK ROOM	250	2	250	1.5	NO	5.0	0.06	25	1	25	0
2nd	217	ASSOCIATE DIRECTOR 4	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
2nd	218	STORAGE ROOM	485	0	330	0.8	NO	5.0	0.12	58	1	58	0
2nd	219	DIRECTOR OFFICE	150	1	150	1.1	YES	5.0	0.06	14	1	14	0
2nd	220	AUDITOR'S CONFERENCE ROOM	275	18	360	1.3	YES	5.0	0.06	107	1	107	0
2nd	221	CONFERENCE ROOM	280	19	370	1.3	NO	5.0	0.06	112	1	112	0
2nd	222	FINANCIAL AND RECEPTION	810	10	170	1.1	NO	5.0	0.06	99	1	99	0
2nd	223	SUPERVISOR OFFICE	105	2	100	1.1	NO	5.0	0.06	16	1	16	0

FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	OCCUPANCY	DESIGNED SA (cfm)	ASHRAE	ASHRAE	ASHRAE 62.1 2004 Required			1=N WING 2=S WING	NORTH WING OA	SOUTH WING OA
						STD 90.1 Lighting	STD 90.1 Compliant	OA Ventilation					
						W/ft <sup>2</sup>	yes/no	cfm/ person	cfm/ft <sup>2</sup>	Total cfm			
2nd	224	COUNSELING OFFICE 4	105	2	135	1.1	NO	5.0	0.06	16	1	16	0
2nd	225	COUNSELING OFFICE 3	135	2	300	1.1	YES	5.0	0.06	18	1	18	0
2nd	226	COUNSELING OFFICE 2	135	2	300	1.1	YES	5.0	0.06	18	1	18	0
2nd	227	COUNSELING OFFICE 1	135	2	300	1.1	YES	5.0	0.06	18	1	18	0
2nd	228	OFFICE SUPPORT WORK AREA	300	3	300	1.1	YES	5.0	0.06	33	1	33	0
2nd	228A	STORAGE / FILE AREA	160	0	100	0.8	NO	5.0	0.12	19	1	19	0
2nd	229	ASSOCIATE DIRECTOR	135	1	300	1.1	YES	5.0	0.06	13	1	13	0
2nd	230	DIRECTOR OFFICE	150	1	470	1.1	YES	5.0	0.06	14	1	14	0
2nd	231	ASSISTANT DIRECTOR	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
2nd	T21	TELECOM & AV ROOM	75	0	----	1.5	NO	5.0	0.06	5	1	5	0
2nd	E21	ELECTRICAL CLOSET	53	0	285	1.5	YES	5.0	0.06	3	1	3	0
2nd	R21	WOMEN TOILET ROOM	235	0	200	0.9	NO	5.0	0.06	14	1	14	0
2nd	R22	MEN TOILET ROOM	225	0	200	0.9	NO	5.0	0.06	14	1	14	0
2nd	V21	VESTIBULE	110	0	----	0.6	YES	5.0	0.06	7	2	0	7
2nd	232	CONFERENCE ROOM 2	630	30	700	1.3	NO	5.0	0.06	188	2	0	188
2nd	233	RECORDS & REGISTRATION RECEPTION	880	8	700	1.1	NO	5.0	0.06	93	2	0	93
2nd	234	OFFICE SUPPORT WORK AREA	240	8	245	1.1	YES	5.0	0.06	54	2	0	54
2nd	235	RECORD ROOM & STORAGE	400	2	300	0.8	NO	5.0	0.12	58	2	0	58
2nd	236	REC SPECIALIST 2	135	2	140	1.1	YES	5.0	0.06	18	2	0	18
2nd	237	REC SPECIALIST 1	135	1	140	1.1	YES	5.0	0.06	13	2	0	13
2nd	238	ASSISTANT DIRECTOR 3	135	2	140	1.1	YES	5.0	0.06	18	2	0	18
2nd	239	ASSISTANT DIRECTOR 2	135	2	140	1.1	YES	5.0	0.06	18	2	0	18
2nd	240	ASSISTANT DIRECTOR 1	135	1	140	1.1	YES	5.0	0.06	13	2	0	13
2nd	241	DIRECTOR OFFICE	150	2	680	1.1	NO	5.0	0.06	19	2	0	19
2nd	242	ADMISSIONS & ADVISING RECEIPT	550	5	200	1.1	NO	5.0	0.06	58	2	0	58
2nd	243	TRANSFER CENTER LAB	1590	50	4250	1.4	YES	5.0	0.06	345	2	0	345
2nd	243A	VISITING TRANSFER REP	130	1	130	1.1	YES	5.0	0.06	13	2	0	13
2nd	243B	TRANSFER ASSISTANT	130	1	130	1.1	YES	5.0	0.06	13	2	0	13
2nd	244	OFFICE SUPPORT WORK AREA	300	3	560	1.1	NO	5.0	0.06	33	2	0	33
2nd	245	WAITING & STUDENT WORK AREA	840	42	840	1.1	YES	5.0	0.06	260	2	0	260
2nd	246	INFORMATION SPECIALIST	515	8	1380	1.1	NO	5.0	0.06	71	2	0	71
2nd	247	OFFICE SUPERVISOR	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	248	DIRECTOR OFFICE	150	1	340	1.1	YES	5.0	0.06	14	2	0	14
2nd	249	ADVISING OFFICE 12	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	250	ADVISING OFFICE 11	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	251	ADVISING OFFICE 10	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	252	ADVISING OFFICE 9	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	253	ADVISING OFFICE 8	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	254	ADVISING OFFICE 7	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	255	ADVISING OFFICE 6	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	256	ADVISING OFFICE 5	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	257	OFFICE SUPPORT STORAGE	205	0	150	0.8	NO	5.0	0.12	25	2	0	25
2nd	258	RECORD ROOM	210	0	165	0.8	NO	5.0	0.06	13	2	0	13
2nd	259	ADVISING OFFICE 4	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	260	ADVISING OFFICE 3	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	261	ASSOCIATE DIRECTOR 5	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	262	ASSOCIATE DIRECTOR 4	135	1	340	1.1	YES	5.0	0.06	13	2	0	13
2nd	263	ASSOCIATE DIRECTOR 3	135	1	410	1.1	YES	5.0	0.06	13	2	0	13
2nd	264	ADVISING OFFICE 2	125	2	310	1.1	YES	5.0	0.06	18	2	0	18
2nd	265	TRANSCRIPT EVALUATOR 2	135	1	130	1.1	YES	5.0	0.06	13	2	0	13
2nd	266	ASSOCIATE DIRECTOR 2	135	2	310	1.1	YES	5.0	0.06	18	2	0	18
2nd	267	TRANSCRIPT EVALUATOR 1	135	1	130	1.1	YES	5.0	0.06	13	2	0	13
2nd	268	ASSOCIATE DIRECTOR 1	135	1	310	1.1	YES	5.0	0.06	13	2	0	13
2nd	269	ADVISING OFFICE 1	125	2	310	1.1	YES	5.0	0.06	18	2	0	18
2nd	C202S	CORRIDOR	815	0	500	0.5	NO	5.0	0.06	49	2	0	49
2nd	C207	CORRIDOR	0	0	----	0.5	YES	5.0	0.06	0	2	0	0
2nd	C208	CORRIDOR	360	0	----	0.5	NO	5.0	0.06	22	2	0	22
2nd	C209	CORRIDOR	1140	0	100	0.5	NO	5.0	0.06	68	2	0	68
2nd	C210	CORRIDOR	170	0	----	0.5	NO	5.0	0.06	10	2	0	10
2nd	E22	ELECTRICAL CLOSET	50	0	285	1.5	NO	5.0	0.06	3	2	0	3
2nd	T22	TELECOM & AV ROOM	50	0	----	1.5	YES	5.0	0.06	3	2	0	3
			24418							3015	LR TOTAL	1241	1775
3rd	300	VENDING ALCOVE	100	0	----	0.5	NO	5.0	0.06	6	1	6	0
3rd	300A	JANITORS CLOSET	20	0	----	0.6	NO	5.0	0.06	1	1	1	0
3rd	301	FAMILY TOILET	63	0	----	0.9	NO	5.0	0.06	4	1	4	0
3rd	302	ACADEMIC SUPPORT, CAREER & COUNCIL	400	10	310	1.1	NO	5.0	0.06	74	1	74	0
3rd	302A	WAITING	230	0	310	1.1	NO	5.0	0.06	14	1	14	0
3rd	303	OFFICE SUPPORT WORK AREA	378	4	440	1.1	NO	5.0	0.06	43	1	43	0
3rd	304	CAREER SERVICE LIBRARY COMPUTERS	1120	25	495	1.4	YES	5.0	0.06	192	1	192	0
3rd	304A	LAB RECEPTION	128	2	100	1.1	YES	5.0	0.06	18	1	18	0
3rd	304B	CAREER SERVICE LIBRARY COMPUTERS	682	15	165	1.4	YES	5.0	0.06	116	1	116	0
3rd	305	CAREER SERVICE COMPUTER LAB	990	20	1800	1.4	YES	5.0	0.06	159	1	159	0
3rd	305A	RECORDS ROOM / STORAGE	105	0	265	0.8	NO	5.0	0.06	6	1	6	0
3rd	306	ASSISTANT DIRECTOR 1	135	1	375	1.1	YES	5.0	0.06	13	1	13	0
3rd	307	ASSISTANT DIRECTOR 2	135	2	150	1.1	YES	5.0	0.06	18	1	18	0
3rd	308	ADMIN 1	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	309	ADMIN 2	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	310	ADMIN 3	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	311	ADMIN 4	135	1	150	1.1	YES	5.0	0.06	13	1	13	0

FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	OCCUPANCY	DESIGNED SA (cfm)	ASHRAE	ASHRAE	ASHRAE 62.1 2004 Required			1=N WING 2=S WING	NORTH WING OA	SOUTH WING OA
						STD 90.1 Lighting	STD 90.1 Compliant	OA Ventilation					
						W/ft <sup>2</sup>	yes/no	cfm/ person	cfm/ft <sup>2</sup>	Total cfm			
3rd	312	ADMIN 5	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	313	ADMIN 6	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	314	ADMIN 7	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	315	ASSISTANT DIRECTOR 3	135	2	150	1.1	YES	5.0	0.06	18	1	18	0
3rd	316	RECORDS ROOM / STORAGE	132	0	---	0.8	NO	5.0	0.06	8	1	8	0
3rd	317	ADMIN 8	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	318	ADMIN 9	135	1	150	1.1	YES	5.0	0.06	13	1	13	0
3rd	319	ASSISTANT DIRECTOR 4	135	2	150	1.1	YES	5.0	0.06	18	1	18	0
3rd	320	ASSISTANT DIRECTOR 5	135	2	350	1.1	YES	5.0	0.06	18	1	18	0
3rd	321	ADMIN 10	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	322	ADMIN 11	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	323	ADMIN 12	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	324	ADMIN 13	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	325	ADMIN 14	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	326	ADMIN 15	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	327	ADMIN 16	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	328	ADMIN 17	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	329	ADMIN 21	135	1	140	1.1	YES	5.0	0.06	13	1	13	0
3rd	330	ASSISTANT DIRECTOR 6	135	2	420	1.1	YES	5.0	0.06	18	1	18	0
3rd	331	ASSISTANT DIRECTOR 7	135	2	500	1.1	YES	5.0	0.06	18	1	18	0
3rd	332	ASSISTANT DIRECTOR 8	135	2	500	1.1	YES	5.0	0.06	18	1	18	0
3rd	333	DIRECTOR OFFICE	150	1	500	1.1	YES	5.0	0.06	14	1	14	0
3rd	334	CONFERENCE ROOM 3	390	20	1840	1.3	NO	5.0	0.06	123	1	123	0
3rd	335	ADMIN 20	135	1	280	1.1	YES	5.0	0.06	13	1	13	0
3rd	336	ADMIN 19	135	1	280	1.1	YES	5.0	0.06	13	1	13	0
3rd	337	ADMIN 18	135	1	280	1.1	YES	5.0	0.06	13	1	13	0
3rd	338	RECORDS ROOM STORAGE	135	0	280	0.8	NO	5.0	0.12	16	1	16	0
3rd	T31	TELECOM & AV	60	0	---	1.5	NO	5.0	0.06	4	1	4	0
3rd	E31	ELECTRICAL CLOSET	45	0	285	1.5	YES	5.0	0.06	3	1	3	0
3rd	C301	CORRIDOR	800	0	400	0.5	NO	5.0	0.06	48	1	48	0
3rd	C301A	CORRIDOR	560	0	1000	0.5	YES	5.0	0.06	34	1	34	0
3rd	C302	CORRIDOR	800	0	500	0.5	NO	5.0	0.06	48	2	0	48
3rd	C303	CORRIDOR	850	0	200	0.5	NO	5.0	0.06	51	1	51	0
3rd	C304	CORRIDOR	220	0	---	0.5	NO	5.0	0.06	13	1	13	0
3rd	C305	CORRIDOR	220	0	---	0.5	NO	5.0	0.06	13	1	13	0
3rd	C306	CORRIDOR	220	0	100	0.5	NO	5.0	0.06	13	1	13	0
3rd	C307	CORRIDOR	360	0	---	0.5	NO	5.0	0.06	22	1	22	0
3rd	R31	WOMEN TOILET ROOM	230	0	175	0.9	NO				1	0	0
3rd	R32	MEN TOILET ROOM	225	0	175	0.9	NO				1	0	0
3rd	339	CONFERENCE ROOM 4	625	30	800	1.3	NO	5.0	0.06	188	2	0	188
3rd	340	RECEPTION	540	4	360	1.1	NO	5.0	0.06	52	2	0	52
3rd	341	OFFICE SUPPORT WORK AREA	255	2	235	1.1	YES	5.0	0.06	25	2	0	25
3rd	342	STORAGE	225	0	1000	0.8	NO	5.0	0.12	27	2	0	27
3rd	343	ADAPTIVE LAB	283	5	290	1.4	YES	5.0	0.06	42	2	0	42
3rd	344	ADMIN 22	135	1	150	1.1	YES	5.0	0.06	13	2	0	13
3rd	345	LAB RECEPTION	150	4	150	1.1	YES	5.0	0.06	29	2	0	29
3rd	346	LAC COMPUTER LAB	925	19	1590	1.4	YES	10.0	0.12	301	2	0	301
3rd	347	LARGE TUTORING LAB	1980	50	1320	1.4	YES	5.0	0.06	369	2	0	369
3rd	348	ADMIN 23	125	1	310	1.1	YES	5.0	0.06	13	2	0	13
3rd	349	ADMIN 24	135	1	310	1.1	YES	5.0	0.06	13	2	0	13
3rd	350	ADMIN 25	135	1	310	1.1	YES	5.0	0.06	13	2	0	13
3rd	351	ASSISTANT DIRECTOR 9	135	2	310	1.1	YES	5.0	0.06	18	2	0	18
3rd	352	LAC WRITE LAB	330	17	590	1.4	YES	10.0	0.12	210	2	0	210
3rd	353	ASSISTANT DIRECTOR 10	135	2	350	1.1	YES	5.0	0.06	18	2	0	18
3rd	354	SMALL TUTORING 1	140	4	350	1.4	YES	5.0	0.06	28	2	0	28
3rd	355	SMALL TUTORING 2	140	4	350	1.4	YES	5.0	0.06	28	2	0	28
3rd	356	SMALL TUTORING 3	140	4	350	1.4	YES	5.0	0.06	28	2	0	28
3rd	357	SMALL TUTORING 4	140	4	350	1.4	YES	5.0	0.06	28	2	0	28
3rd	358	ASSISTANT DIRECTOR 11	140	2	350	1.1	YES	5.0	0.06	18	2	0	18
3rd	359	TEST CENTER RECEPTION	335	4	340	1.1	NO	5.0	0.06	40	2	0	40
3rd	360	LARGE TESTING ROOM	1580	32	3920	1.4	YES	7.5	0.06	335	2	0	335
3rd	361	TEST CENTER COORDINATOR	140	2	135	1.1	YES	5.0	0.06	18	2	0	18
3rd	362	STORAGE	370	0	100	0.8	NO	5.0	0.12	44	2	0	44
3rd	363	TOILET	42	0	---	0.9	NO				2	0	0
3rd	364	TOILET	42	0	---	0.9	NO				2	0	0
3rd	365	OFFICE SUPPORT WORK AREA	125	2	135	1.1	YES	5.0	0.06	18	2	0	18
3rd	366	TEST CENTER RECEPTION	330	4	690	1.1	NO	5.0	0.06	40	2	0	40
3rd	367	COMPUTER PLACEMENT TESTING ROOM	900	16	2040	1.4	YES	7.5	0.06	174	2	0	174
3rd	368	PROMETRIC TESTING ROOM	415	8	1095	1.4	NO	5.0	0.06	65	2	0	65
3rd	369	READER/ WRITER TESTING ROOM	135	3	350	1.4	YES	5.0	0.06	23	2	0	23
3rd	370	READER/ WRITER TESTING ROOM	135	3	350	1.4	YES	5.0	0.06	23	2	0	23
3rd	E32	ELECTRICAL CLOSET	50	0	285	1.5	YES	5.0	0.06	3	2	0	3
3rd	T32	TELECOM & AV	50	0	---	1.5	YES	5.0	0.06	3	2	0	3
3rd	C309	CORRIDOR	400	0	100	0.5	NO	5.0	0.06	24	2	0	24
3rd	C310	CORRIDOR	380	0	200	0.5	NO	5.0	0.06	23	2	0	23
			25770							3753	LR TOTAL	1409	2343
												12"/10X10	14"/12X12
4th	400	PRIVATE DINING ROOM 1	2988	200	6660	0.9	NO	7.5	0.18	2038	2	0	2038
4th	400A	TERRACE	1385	92	---	0.9	YES				2	0	0
4th	401	PRIVATE DINING ROOM 2	1360	90	2700	0.9	YES	7.5	0.18	920	2	0	920





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# RETScreen® International

Clean Energy Project Analysis Software

## Ground-Source Heat Pump Project Model

### Click Here to Start

Description & Flow Chart

Colour Coding

Online Manual

### Worksheets

Energy Model

Heating & Cooling Load

Cost Analysis

Greenhouse Gas Analysis

Financial Summary

### Features

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Sensitivity Analysis



### Clean Energy Decision Support Centre

[www.retscreen.net](http://www.retscreen.net)

Training & Support

Internet Forums

Marketplace

Case Studies

e-Textbook

### Partners




Site Conditions	Estimate	Notes/Range
Project name	<b>HCC SSB</b>	<a href="#">See Online Manual</a>  <a href="#">Complete H&amp;CLC sheet</a>
Project location	<b>Howard Co, Md</b>	
Available land area	m <sup>2</sup> 10,000	
Soil type	- Light rock	
Design heating load	kW 666.0	
Design cooling load	kW 1,343.4	

System Characteristics	Estimate	Notes/Range
<b>Base Case HVAC System</b>		
Building has air-conditioning?	yes/no <b>Yes</b>	
Heating fuel type	- <b>Natural gas</b>	
Heating system seasonal efficiency	% 65%	55% to 350%
Air-conditioner seasonal COP	- 3.0	2.4 to 5.0
<b>Ground Heat Exchanger System</b>		
System type	- Vertical closed-loop	
Design criteria	- Cooling	
Typical land area required	m <sup>2</sup> 3,648	
Ground heat exchanger layout	- Standard	
Total borehole length	m 12,548	
<b>Heat Pump System</b>		
Average heat pump efficiency	- High	
Standard cooling COP	- 5.50	
Standard heating COP	- 4.00	
Total standard heating capacity	kW 922.1	
	million Btu/h 3.146	
Total standard cooling capacity	kW 1,334.0	
	ton (cooling) 379.4	
<b>Supplemental Heating and Heat Rejection System</b>		
Suggested supplemental heating capacity	kW 0.0	
	million Btu/h 0.000	
Suggested supplemental heat rejection	kW 0.0	
	ton (cooling) 0.0	

Annual Energy Production	Estimate	Notes/Range
<b>Heating</b>		
Electricity used	MWh 8.4	
Supplemental energy delivered	MWh 0.0	
GSHP heating energy delivered	MWh <b>21.3</b>	
	million Btu 72.6	
Seasonal heating COP	- 2.5	2.0 to 5.0
<b>Cooling</b>		
Electricity used	MWh 65.1	
GSHP cooling energy delivered	MWh <b>298.7</b>	
	million Btu 1,019.3	
Seasonal cooling COP	- 4.6	2.0 to 5.5
Seasonal cooling EER	(Btu/h)/W 15.7	7.0 to 19.0
<a href="#">Complete Cost Analysis sheet</a>		



Site Conditions		Estimate	Notes/Range
Project name		HCC SSB	<a href="#">See Online Manual</a>
Project location		Howard Co, Md	
Available land area	m <sup>2</sup>	10,000	
Soil type	-	Light rock	
Design heating load	kW	666.0	
Design cooling load	kW	1,343.4	 <a href="#">Complete H&amp;CLC sheet</a>

System Characteristics		Estimate	Notes/Range	
<b>Base Case HVAC System</b>				
Building has air-conditioning?	yes/no	Yes	55% to 350% 2.4 to 5.0	
Heating fuel type	-	Natural gas		
Heating system seasonal efficiency	%	65%		
Air-conditioner seasonal COP	-	3.0		
<b>Ground Heat Exchanger System</b>				
System type	-	Vertical closed-loop		
Design criteria	-	Heating		
Typical land area required	m <sup>2</sup>	1,051		
Ground heat exchanger layout	-	Standard		
Total borehole length	m	3,649		
<b>Heat Pump System</b>				
Average heat pump efficiency	-	High		
Standard cooling COP	-	5.50		
Standard heating COP	-	4.00		
Total standard heating capacity	kW	922.1		
	million Btu/h	3.146		
Total standard cooling capacity	kW	1,334.0		
	ton (cooling)	379.4		
<b>Supplemental Heating and Heat Rejection System</b>				
Suggested supplemental heating capacity	kW	0.0		
	million Btu/h	0.000		
Suggested supplemental heat rejection	kW	952.7		
	ton (cooling)	271.0		

Annual Energy Production		Estimate	Notes/Range
<b>Heating</b>			
Electricity used	MWh	7.5	2.0 to 5.0
Supplemental energy delivered	MWh	0.0	
GSHP heating energy delivered	MWh	21.3	
	million Btu	72.6	
Seasonal heating COP	-	2.8	
<b>Cooling</b>			
Electricity used	MWh	62.1	2.0 to 5.5 7.0 to 19.0
GSHP cooling energy delivered	MWh	298.7	
	million Btu	1,019.3	
Seasonal cooling COP	-	4.8	
Seasonal cooling EER	(Btu/h)/W	16.4	

[Complete Cost Analysis sheet](#)

## RETScreen® Heating and Cooling Load Calculation - Ground-Source Heat Pump Project

Site Conditions		Estimate	Notes/Range
Nearest location for weather data		Baltimore, MD	<a href="#">See Weather Database</a>
Heating design temperature	°C	-10.6	-40.0 to 15.0
Cooling design temperature	°C	32.8	10.0 to 40.0
Average summer daily temperature range	°C	8.1	5.0 to 15.0
Cooling humidity level	-	Medium	
Latitude of project location	°N	39.2	-90.0 to 90.0
Mean earth temperature	°C	12.8	<a href="#">Visit NASA satellite data site</a>
Annual earth temperature amplitude	°C	19.8	5.0 to 20.0
Depth of measurement of earth temperature	m	0.0	0.0 to 3.0

Building Heating and Cooling Load		Estimate	Notes/Range
Type of building	-	Commercial	
Available information	-	Energy use data	
Design heating load	kW	666.0	
	million Btu/h	2.272	
Annual heating energy demand	MWh	4.3	
	million Btu	14.7	
Design cooling load	kW	1,343.4	
	ton (cooling)	382.1	
Annual cooling energy demand	MWh	23.8	
	million Btu	81.2	<a href="#">Return to Energy Model sheet</a>

Version 3.1

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RETScreen® Cost Analysis - Ground-Source Heat Pump Project

Type of analysis: Feasibility

Currency: \$

Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
<b>Feasibility Study</b>							
Site investigation	p-h	10	\$ 65	\$ 650	-	-	-
Soil/hydrology assessment	p-h	25	\$ 65	\$ 1,625	-	-	-
Preliminary design	p-h	14	\$ 75	\$ 1,050	-	-	-
Detailed cost estimate	p-h	13	\$ 75	\$ 975	-	-	-
Report preparation	p-h	16	\$ 75	\$ 1,200	-	-	-
Travel and accommodation	p-trip	0	\$ -	\$ -	-	-	-
Other - Feasibility Study	Cost	0	\$ -	\$ -	-	-	-
Credit - Feasibility Study	Credit	1	\$ 3,000	\$ (3,000)	-	-	-
Sub-total:				\$ 2,500	0.4%		
<b>Development</b>							
Permits and approvals	p-h	10	\$ 65	\$ 650	-	-	-
Land survey	p-h	10	\$ 65	\$ 650	-	-	-
Project financing	p-h	14	\$ 90	\$ 1,260	-	-	-
Project management	p-h	25	\$ 75	\$ 1,875	-	-	-
Travel and accommodation	p-trip	0	\$ -	\$ -	-	-	-
Other - Development	Cost	0	\$ -	\$ -	-	-	-
Credit - Development	Credit	1	\$ 2,500	\$ (2,500)	-	-	-
Sub-total:				\$ 1,935	0.3%		
<b>Engineering</b>							
GSHP system design	p-h	35	\$ 75	\$ 2,625	-	-	-
Tenders and contracting	p-h	25	\$ 65	\$ 1,625	-	-	-
Construction supervision	p-h	25	\$ 75	\$ 1,875	-	-	-
Other - Engineering	Cost	0	\$ -	\$ -	-	-	-
Credit - Engineering	Credit	1	\$ 4,500	\$ (4,500)	-	-	-
Sub-total:				\$ 1,625	0.2%		
<b>Energy Equipment</b>							
Heat pumps	kW cooling	1,334.0	\$ 248	\$ 331,174	-	-	-
Well pumps	kW	0.0	\$ -	\$ -	-	-	-
Circulating pumps	kW	22.7	\$ 850	\$ 19,277	-	-	-
Circulating fluid	m³	0.64	\$ 2,600	\$ 1,677	-	-	-
Plate heat exchangers	kW	0.0	\$ -	\$ -	-	-	-
Trenching and backfilling	m	0	\$ -	\$ -	-	-	-
Drilling and grouting	m	3,649	\$ 39.37	\$ 143,665	-	-	-
Ground HX loop pipes	m	7,298	\$ 3.41	\$ 24,887	-	-	-
Fittings and valves	kW cooling	1,334.0	\$ 12.00	\$ 16,008	-	-	-
Other - Energy Equipment	Cost	300	\$ 4	\$ 1,200	-	-	-
Electric central heating system	Credit	1	\$ 20,000	\$ (20,000)	-	-	-
Sub-total:				\$ 517,888	72.5%		
<b>Balance of System</b>							
Supplemental heating system	kW	0.0	\$ -	\$ -	-	-	-
Supplemental heat rejection	kW	952.7	\$ 18	\$ 17,067	-	-	-
Internal piping and insulation	kW cooling	1,334.0	\$ 60	\$ 80,042	-	-	-
Other - Plate Heat Exchanger	Cost	0	\$ -	\$ -	-	-	-
Credit - Balance of System	Credit	1	\$ 1,000	\$ (1,000)	-	-	-
Sub-total:				\$ 96,109	13.5%		
<b>Miscellaneous</b>							
Training	p-h	14	\$ 70	\$ 980	-	-	-
Contingencies	%	15%	\$ 621,037	\$ 93,156	-	-	-
Sub-total:				\$ 94,136	13.2%		
<b>Initial Costs - Total</b>				\$ 714,193	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
<b>O&amp;M</b>							
Property taxes/Insurance	project	0	\$ -	\$ -	-	-	-
O&M labour	m²	1,000	\$ 2.50	\$ 2,500	-	-	-
Travel and accommodation	p-trip	0	\$ -	\$ -	-	-	-
Other - O&M	Cost	0	\$ -	\$ -	-	-	-
Credit - O&M	Credit	1	\$ 3,500	\$ (3,500)	-	-	-
Contingencies	%	5%	\$ 620,057	\$ 31,003	-	-	-
Sub-total:				\$ 30,003	226.7%		
<b>Fuel/Electricity</b>							
Electricity	kWh	69,563	\$ 0.060	\$ 4,174	-	-	-
Incremental electricity load	kW	-174.5	\$ 120	\$ (20,944)	-	-	-
Sub-total:				\$ (16,770)	-126.7%		
<b>Annual Costs - Total</b>				\$ 13,233	100.0%		

Periodic Costs (Credits)	Period	Unit Cost	Amount	Interval Range	Unit Cost Range
Heat pump compressor	Cost	10 yr	\$ 5,000	-	-
Air-conditioner replacement	Credit	12 yr	\$ 6,000	-	-
			\$ -	-	-
End of project life	Credit	-	\$ 2,000	-	-

[Go to GHG Analysis sheet](#)

# Certified Drawing for 5 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:38PM

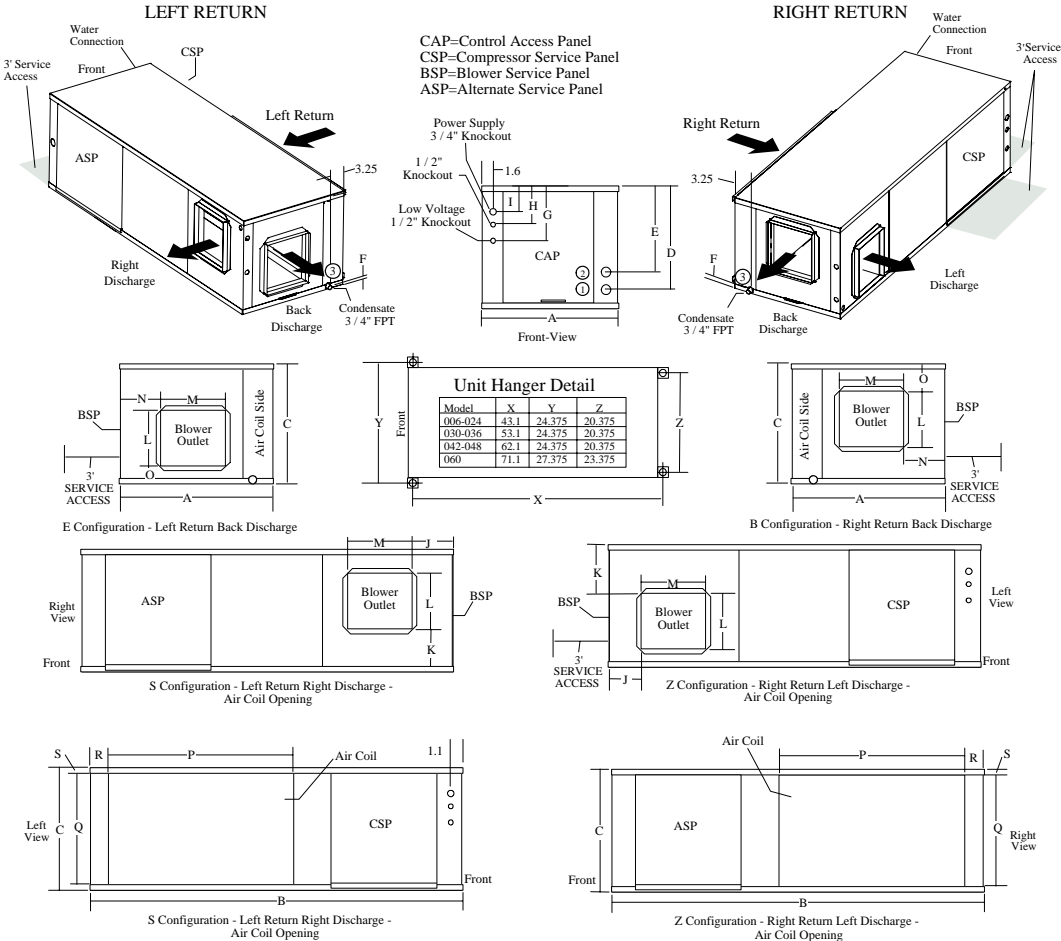


## 50RHR006-060 UNITS

50RHR UNITS	OVERALL CABINET			WATER CONNECTIONS				ELECTRICAL KNOCKOUTS (in.)			DISCHARGE CONNECTION Duct Flange Installed (±0.10 in.)					RETURN CONNECTION Using Return Air Opening					
				1	2	3	Loop Water FPT	G 1/2 conduit	H 1/2 conduit	I 3/4 conduit	J	K	L Supply Height	M Supply Depth	N	O	P Return Depth	Q Return Height	R	S	
	A Width	B Depth	C Height	D In	E Out	F Condensate		Low Voltage	Ext Pump	Power Supply											
006-012	in. cm	22.4 56.8	43.1 109.5	11.3 28.7	2.4 6.1	5.4 13.7	0.6 1.5	1/2	3.5 8.9	5.5 14.0	8.2 20.8	5.8 14.7	4.0 10.2	5.8 14.7	8.0 20.3	5.8 14.7	1.5 3.8	17.1 43.4	9.3 23.6	2.2 5.6	1.0 2.5
015-024	in. cm	22.4 56.8	43.1 109.5	17.3 43.9	2.4 6.1	4.9 12.4	0.6 1.5	3/4	3.5 8.9	7.5 19.1	10.2 25.9	5.0 12.7	5.6 14.2	10.4 26.4	9.3 23.6	5.0 12.7	1.5 3.8	17.1 43.4	15.3 38.9	2.2 5.6	1.0 2.5
030	in. cm	22.4 56.8	53.2 135.1	19.3 49.0	2.4 6.1	5.4 13.7	0.6 1.5	3/4	5.7 14.5	9.7 24.6	12.2 31.0	5.0 12.7	6.8 17.3	10.4 26.4	9.3 23.6	5.0 12.7	2.1 5.3	23.1 58.7	17.3 43.9	2.2 5.6	1.0 2.5
036	in. cm	22.4 56.8	53.2 135.1	19.3 49.0	2.4 6.1	5.4 13.7	0.6 1.5	3/4	5.7 14.5	9.7 24.6	12.2 31.0	2.9 7.4	3.8 9.7	13.5 34.3	13.1 33.3	2.9 7.4	1.9 4.8	23.1 58.7	17.3 43.9	2.2 5.6	1.0 2.5
042-048	in. cm	22.4 56.8	62.2 158.0	19.3 49.0	2.4 6.1	5.4 13.7	0.6 1.5	1	5.7 14.5	9.7 24.6	12.2 31.0	2.9 7.4	3.8 9.7	13.5 34.3	13.1 33.3	2.9 7.4	1.9 4.8	32.1 81.5	17.3 43.9	2.2 5.6	1.0 2.5
060	in. cm	25.4 64.5	71.2 180.8	21.3 54.1	2.4 6.1	5.4 13.7	0.6 1.5	1	8.1 20.6	11.7 29.7	14.2 36.1	5.8 14.7	5.0 12.7	13.6 34.5	13.3 33.8	5.8 14.7	2.9 7.4	36.1 91.7	19.3 49.0	2.2 5.6	1.0 2.5

**NOTES:**

1. Condensate is 3/4-in. FPT copper.
2. Horizontal unit shipped with filter bracket only. This bracket should be removed for return duct connection.
3. Hanger kit is factory installed. Isolation grommets are provided.
4. Right and left orientation is determined by looking at water connection side.



AIRFLOW CONFIGURATION		
Code	Return	Discharge
S	Left	Right
E	Left	Back
Z	Right	Left
B	Right	Back

## Performance Summary For 0.5 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**0.5 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR006SCC3--20**  
Unit Size: ..... **0.5 Tons, 200 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **1.1** gpm  
Fluid Pressure Drop:..... **2.0** ft wg  
Airflow:..... **210.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-1-60** V-Ph-Hz  
Compressor LRA: ..... **17.7** Amps  
Compressor RLA: ..... **2.9** Amps  
Fan FLA:..... **0.3** Amps  
Total FLA:..... **3.2** Amps  
Max fuse amps: ..... **15** Amps  
Min Circuit Amps: ..... **3.9** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **6.3** MBH  
Sensible Cooling: ..... **3.8** MBH  
EER: ..... **11.1**  
Cooling kW: ..... **0.6** kW  
Heat of Rejection: ..... **8.2** MBH  
Leaving Air DB Temp.: ..... **63.9** F  
Leaving Air WB Temp.: ..... **61.0** F  
Cooling LWT: ..... **99.9** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **102.7** F  
Total Heating: ..... **7.9** MBH  
COP: ..... **4.0**  
Heating kW: ..... **0.6** kW  
Heat of Absorbtion: ..... **5.9** MBH  
Heating LWT: ..... **64.3** F

## Performance Summary For 0.75 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**0.75 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR009SCC3--20**  
Unit Size: ..... **0.75 Tons, 300 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **1.6** gpm  
Fluid Pressure Drop:..... **4.7** ft wg  
Airflow:..... **360.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-1-60** V-Ph-Hz  
Compressor LRA: ..... **22.2** Amps  
Compressor RLA: ..... **3.9** Amps  
Fan FLA:..... **0.8** Amps  
Total FLA:..... **4.7** Amps  
Max fuse amps: ..... **15** Amps  
Min Circuit Amps: ..... **5.7** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **8.1** MBH  
Sensible Cooling: ..... **5.7** MBH  
EER: ..... **10.6**  
Cooling kW: ..... **0.8** kW  
Heat of Rejection: ..... **10.7** MBH  
Leaving Air DB Temp.: ..... **66.0** F  
Leaving Air WB Temp.: ..... **63.4** F  
Cooling LWT: ..... **97.9** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **95.6** F  
Total Heating: ..... **10.7** MBH  
COP: ..... **4.2**  
Heating kW: ..... **0.8** kW  
Heat of Absorbtion: ..... **8.2** MBH  
Heating LWT: ..... **65.1** F

## Performance Summary For 1 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**1 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR012SCC3--20**  
Unit Size: ..... **1 Tons, 375 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **2.2** gpm  
Fluid Pressure Drop:..... **9.1** ft wg  
Airflow:..... **330.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-1-60** V-Ph-Hz  
Compressor LRA: ..... **27.9** Amps  
Compressor RLA: ..... **5.3** Amps  
Fan FLA:..... **0.8** Amps  
Total FLA:..... **6.1** Amps  
Max fuse amps: ..... **15** Amps  
Min Circuit Amps: ..... **7.4** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **11.9** MBH  
Sensible Cooling: ..... **7.5** MBH  
EER: ..... **12.1**  
Cooling kW: ..... **1.0** kW  
Heat of Rejection: ..... **15.2** MBH  
Leaving Air DB Temp.: ..... **59.7** F  
Leaving Air WB Temp.: ..... **59.0** F  
Cooling LWT: ..... **98.8** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **110.0** F  
Total Heating: ..... **15.0** MBH  
COP: ..... **4.0**  
Heating kW: ..... **1.1** kW  
Heat of Absorbtion: ..... **11.3** MBH  
Heating LWT: ..... **64.8** F

## Performance Summary For 1.25 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:..... **1.25 tons**  
Quantity: ..... **1**  
Part Number: ..... **50RHR015SCC3--20**  
Unit Size: ..... **1.25 Tons, 500 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **2.8** gpm  
Fluid Pressure Drop:..... **3.7** ft wg  
Airflow:..... **565.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-1-60** V-Ph-Hz  
Compressor LRA: ..... **29** Amps  
Compressor RLA: ..... **6.1** Amps  
Fan FLA:..... **1** Amps  
Total FLA:..... **7.1** Amps  
Max fuse amps: ..... **15** Amps  
Min Circuit Amps: ..... **8.6** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **14.4** MBH  
Sensible Cooling: ..... **10.1** MBH  
EER: ..... **14.0**  
Cooling kW: ..... **1.0** kW  
Heat of Rejection: ..... **17.9** MBH  
Leaving Air DB Temp.: ..... **64.0** F  
Leaving Air WB Temp.: ..... **62.5** F  
Cooling LWT: ..... **98.0** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **96.5** F  
Total Heating: ..... **17.4** MBH  
COP: ..... **5.4**  
Heating kW: ..... **1.0** kW  
Heat of Absorbtion: ..... **14.2** MBH  
Heating LWT: ..... **64.7** F



## Performance Summary For 1.5 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:..... **1.5 tons**  
Quantity: ..... **1**  
Part Number: ..... **50RHR019SCC3--20**  
Unit Size: ..... **1.5 Tons, 600 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **3.3** gpm  
Fluid Pressure Drop:..... **6.3** ft wg  
Airflow:..... **580.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-1-60** V-Ph-Hz  
Compressor LRA: ..... **49** Amps  
Compressor RLA: ..... **8.6** Amps  
Fan FLA:..... **1.1** Amps  
Total FLA:..... **9.7** Amps  
Max fuse amps: ..... **20** Amps  
Min Circuit Amps: ..... **11.8** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **19.3** MBH  
Sensible Cooling: ..... **11.9** MBH  
EER: ..... **11.8**  
Cooling kW: ..... **1.6** kW  
Heat of Rejection: ..... **24.8** MBH  
Leaving Air DB Temp.: ..... **61.6** F  
Leaving Air WB Temp.: ..... **59.9** F  
Cooling LWT: ..... **100.1** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **108.5** F  
Total Heating: ..... **25.4** MBH  
COP: ..... **4.4**  
Heating kW: ..... **1.7** kW  
Heat of Absorbtion: ..... **19.5** MBH  
Heating LWT: ..... **63.1** F

## Performance Summary For 2 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**2 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR024SCC5--20**  
Unit Size: ..... **2 Tons, 800 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **4.4** gpm  
Fluid Pressure Drop:..... **10.4** ft wg  
Airflow:..... **680.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-3-60** V-Ph-Hz  
Compressor LRA: ..... **51** Amps  
Compressor RLA: ..... **6.7** Amps  
Fan FLA:..... **1.3** Amps  
Total FLA:..... **8** Amps  
Max fuse amps: ..... **15** Amps  
Min Circuit Amps: ..... **9.7** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **22.8** MBH  
Sensible Cooling: ..... **14.0** MBH  
EER: ..... **11.8**  
Cooling kW: ..... **1.9** kW  
Heat of Rejection: ..... **29.4** MBH  
Leaving Air DB Temp.: ..... **61.6** F  
Leaving Air WB Temp.: ..... **59.8** F  
Cooling LWT: ..... **98.4** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **105.5** F  
Total Heating: ..... **27.6** MBH  
COP: ..... **3.9**  
Heating kW: ..... **2.1** kW  
Heat of Absorbtion: ..... **20.5** MBH  
Heating LWT: ..... **65.7** F

## Performance Summary For 3 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**3 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR036SCC5--20**  
Unit Size: ..... **3 Tons, 1200 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **6.6** gpm  
Fluid Pressure Drop:..... **4.0** ft wg  
Airflow:..... **1,080.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-3-60** V-Ph-Hz  
Compressor LRA: ..... **65.5** Amps  
Compressor RLA: ..... **9.4** Amps  
Fan FLA:..... **3** Amps  
Total FLA:..... **12.4** Amps  
Max fuse amps: ..... **20** Amps  
Min Circuit Amps: ..... **14.7** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **34.2** MBH  
Sensible Cooling: ..... **21.6** MBH  
EER: ..... **12.4**  
Cooling kW: ..... **2.8** kW  
Heat of Rejection: ..... **43.6** MBH  
Leaving Air DB Temp.: ..... **62.1** F  
Leaving Air WB Temp.: ..... **60.4** F  
Cooling LWT: ..... **98.2** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **104.8** F  
Total Heating: ..... **42.9** MBH  
COP: ..... **4.0**  
Heating kW: ..... **3.2** kW  
Heat of Absorbtion: ..... **32.2** MBH  
Heating LWT: ..... **65.2** F

## Performance Summary For 2.5 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**2.5 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR030SCC5--20**  
Unit Size: ..... **2.5 Tons, 1000 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **5.5** gpm  
Fluid Pressure Drop:..... **5.0** ft wg  
Airflow:..... **1,030.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-3-60** V-Ph-Hz  
Compressor LRA: ..... **55** Amps  
Compressor RLA: ..... **6.9** Amps  
Fan FLA:..... **1.9** Amps  
Total FLA:..... **8.8** Amps  
Max fuse amps: ..... **15** Amps  
Min Circuit Amps: ..... **10.6** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **28.9** MBH  
Sensible Cooling: ..... **20.0** MBH  
EER: ..... **12.4**  
Cooling kW: ..... **2.3** kW  
Heat of Rejection: ..... **36.9** MBH  
Leaving Air DB Temp.: ..... **62.6** F  
Leaving Air WB Temp.: ..... **61.6** F  
Cooling LWT: ..... **98.4** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **99.4** F  
Total Heating: ..... **35.0** MBH  
COP: ..... **4.4**  
Heating kW: ..... **2.3** kW  
Heat of Absorbtion: ..... **27.0** MBH  
Heating LWT: ..... **65.2** F

## Performance Summary For 3.5 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**3.5 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR042SCC5--20**  
Unit Size: ..... **3.5 Tons, 1400 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **7.7** gpm  
Fluid Pressure Drop:..... **5.5** ft wg  
Airflow:..... **1,100.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-3-60** V-Ph-Hz  
Compressor LRA: ..... **75** Amps  
Compressor RLA: ..... **10.3** Amps  
Fan FLA:..... **3** Amps  
Total FLA:..... **13.3** Amps  
Max fuse amps: ..... **25** Amps  
Min Circuit Amps: ..... **15.9** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **39.9** MBH  
Sensible Cooling: ..... **24.0** MBH  
EER: ..... **12.5**  
Cooling kW: ..... **3.2** kW  
Heat of Rejection: ..... **50.8** MBH  
Leaving Air DB Temp.: ..... **60.4** F  
Leaving Air WB Temp.: ..... **58.9** F  
Cooling LWT: ..... **98.2** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **108.3** F  
Total Heating: ..... **47.8** MBH  
COP: ..... **4.0**  
Heating kW: ..... **3.5** kW  
Heat of Absorbtion: ..... **35.9** MBH  
Heating LWT: ..... **65.7** F

## Performance Summary For 4 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:..... **4 tons**  
Quantity: ..... **1**  
Part Number: ..... **50RHR048SCC5--20**  
Unit Size: ..... **4 Tons, 1600 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **8.8** gpm  
Fluid Pressure Drop:..... **9.2** ft wg  
Airflow:..... **1,670.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: ..... **.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-3-60** V-Ph-Hz  
Compressor LRA: ..... **91** Amps  
Compressor RLA: ..... **12.6** Amps  
Fan FLA:..... **3.4** Amps  
Total FLA:..... **16** Amps  
Max fuse amps: ..... **30** Amps  
Min Circuit Amps: ..... **19.2** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **48.8** MBH  
Sensible Cooling: ..... **32.0** MBH  
EER: ..... **12.6**  
Cooling kW: ..... **3.9** kW  
Heat of Rejection: ..... **62.1** MBH  
Leaving Air DB Temp.: ..... **62.9** F  
Leaving Air WB Temp.: ..... **61.2** F  
Cooling LWT: ..... **99.1** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **103.0** F  
Total Heating: ..... **63.1** MBH  
COP: ..... **4.4**  
Heating kW: ..... **4.2** kW  
Heat of Absorbtion: ..... **48.7** MBH  
Heating LWT: ..... **63.9** F

## Performance Summary For 5 tons

Project: Jason WSHps  
Prepared By:

04/03/2006  
03:42PM

### Unit Parameters

Tag Name:.....**5 tons**  
Quantity: ..... **1**  
Part Number: .....**50RHR060SCC5--20**  
Unit Size: ..... **5 Tons, 2000 CFM**  
Fluid Type:..... **Water**  
Fluid Concentration: ..... **0** %  
Fluid Flow Rate: ..... **11.** gpm  
Fluid Pressure Drop:..... **12.9** ft wg  
Airflow:..... **1,825.0** CFM  
Altitude: ..... **0** ft  
External Static Pressure: .....**.05** in wg  
Fan Speed:..... **LOW**

### Electrical

Voltage: ..... **208/230-3-60** V-Ph-Hz  
Compressor LRA: ..... **124** Amps  
Compressor RLA: ..... **14.7** Amps  
Fan FLA:..... **4.3** Amps  
Total FLA:..... **19** Amps  
Max fuse amps: ..... **35** Amps  
Min Circuit Amps: ..... **22.7** Amps  
Min/Max Voltage:..... **197/254** Volts

### Design Requirements

#### Cooling

Loop Temp Cooling: ..... **85.0** F  
Cooling Ent. Air DB Temp.: ..... **80.6** F  
Cooling Ent. Air WB Temp.: ..... **70.0** F  
Total Cooling: ..... **60.9** MBH  
Sensible Cooling: ..... **38.6** MBH  
EER: ..... **12.6**  
Cooling kW: ..... **4.8** kW  
Heat of Rejection: ..... **77.4** MBH  
Leaving Air DB Temp.: ..... **61.0** F  
Leaving Air WB Temp.: ..... **59.8** F  
Cooling LWT: ..... **99.1** F

#### Heating

Loop Temp Heating: ..... **75.0** F  
Heating Ent. air DB Temp.: ..... **68.0** F  
Heating Leaving air Temp.: ..... **104.1** F  
Total Heating: ..... **71.2** MBH  
COP: ..... **4.4**  
Heating kW: ..... **4.8** kW  
Heat of Absorbtion: ..... **55.0** MBH  
Heating LWT: ..... **65.0** F

WSHP Pricing					
Description	Size	Units	Price	Quantity	Total
Water source heat pump	0.5	tons	\$1,155.00	49	\$56,595.00
Water source heat pump	0.75	tons	\$1,200.00	18	\$21,600.00
Water source heat pump	1	tons	\$1,250.00	21	\$26,250.00
Water source heat pump	1.25	tons	\$1,400.00	9	\$12,600.00
Water source heat pump	1.5	tons	\$1,500.00	5	\$7,500.00
Water source heat pump	2	tons	\$1,600.00	5	\$8,000.00
Water source heat pump	2.5	tons	\$1,700.00	2	\$3,400.00
Water source heat pump	3	tons	\$1,800.00	6	\$10,800.00
Water source heat pump	3.5	tons	\$2,000.00	5	\$10,000.00
Water source heat pump	4	tons	\$2,200.00	5	\$11,000.00
Water source heat pump	5	tons	\$2,400.00	36	\$86,400.00
WSHP (Kitchen)	50	tons	\$38,500.00	2	\$77,000.00
TOTAL				163	\$331,145.00

Equipment & Material Initial Costs			
Description	Geo Thermal cost		As Designed cost
Heat Exchange Fluid	\$ 1,677.00		\$ -
Circulation Pumps	\$ 19,227.00		\$ 25,462.00
Air Handling Units	\$ 110,000.00		\$ 738,167.00
VAV boxes	\$ -		\$ 41,000.00
Water Source Heat Pumps	\$ 331,145.00		\$ -
Drilling & Grout	\$ 203,524.00		\$ -
Ground loop piping	\$ 24,887.00		\$ -
Fittings and Valves	\$ 16,008.00		\$ -
Building HVAC Piping	\$ 901,500.00		\$ 655,500.00
Chiller	\$ -		\$ 250,000.00
Cooling tower	\$ 29,200.00		\$ 44,700.00
Plate heat exchanger	\$ 47,300.00		\$ -
Sheet metal	\$ 132,755.00		\$ 879,400.00
Totals	\$ 1,817,223.00		\$ 2,634,229.00





# EMJAY Engineering & Construction

## Heating, Ventilation, Air Conditioning

Project: Student Services Bldg. HCC

Spec. Section	Description	Total
	Access Doors	\$200.00
15181-5	Air Vents Auto- (30) Man-(111)	\$4,428.00
15050-9	Floor and Ceiling Plates	\$188.00
15050-14	Foundations	\$0.00
15050-8	Sleeves	\$0.00
15122-3	Pressure Gauges (67)	\$2,755.00
15122-2	Thermometers (36)	\$3,208.00
15075-2	Identification	\$2,540.00
15075-3	Valve Tags	\$774.00
15075-3	Valve Charts	\$0.00
	Starters	\$0.00
	Steel for Supports	\$3,020.00
15060-7	Saddles	\$1,200.00
	<b>Technical Sections</b>	\$0.00
15050-7	Flex Conn.11/2(8)11/4(4)1(2)8(12)	\$4,482.00
15050-8	Linkseal	\$344.00
15050-10	Drip Pans	\$0.00
15050-10	Roof Curbs	\$472.00
15050-13	Firestopping	\$3,232.00
15056-1	Power Factor Correction	\$0.00
15071-1	Vibration Control	\$6,960.00
15071-9	Anchor2(25)11/2(18)11/4(17)1(5)	\$3,790.00
15071-9	Guide2(28)11/2(22)11/4(27)1(7)	\$6,384.00
15121-2	Expansion Comp 3(4)2(2)	\$1,828.00
15122-3	Thermowell (4)	\$136.00
15122-3	Petes Plug (58)	\$555.00
15122-2	Remote mount thermometer	\$0.00
15181-5	Safety Valves 2"(2)	\$44.00
15181-5	PRV Valve Oil 3/4" (1)	\$163.00
15181-5	Expansion Tank (2)	\$0.00
15181-6	Air Separator (2)	\$0.00
15181-6	Flow Meter1(1)2(4)1 1/2(1)4(3) ✓	\$4,387.00
15181-11	Chemical Cleaning	\$378.00
15183-2	Refrigerant	\$200.00
15183-3	Refrigeration Spec.	\$944.00
15185-3	End Suction Pump (5)	\$0.00
15185-2	In-line Pump (10)	\$0.00
15185-4	Suction Diffuser8(3)6(2)	\$0.00
15189-1	Water Treatment	\$12,561.00
15210-3	Duplex Fuel Oil Pump Set (1)	\$6,728.00
15210-2	Oil Solenoid Valve (2)	\$344.00
15210-3	Oil PRV 3/4" (1)	\$174.00
15210-2	Vent Cap	\$50.00
15210-2	Hydraulic Tank Gauge	\$0.00
15210-4	Paint Oil Piping	\$496.00
15512-1	Cast Iron Boilers (2)	\$45,576.00
15625-1	Chillers (1)	\$0.00
15625-8	Maintenance on Chiller	\$0.00
15635-1	Refrigerant Monitor (1)	\$0.00
15641-1	Cooling Towers (1)	\$52,266.00
15720-1	Rooftop AHU (3)	\$0.00
15725-1	Modular AHU (3)	\$0.00
15738-1	Split System A/C Unit (8)	\$0.00



## Analysis Details

Project: Student Services Building  
 Prepared By: The Pennsylvania State University

4/10/2006  
 9:03:13 PM

### Geothermal Economics

Type of Analysis ..... Public Sector Lifecycle Analysis  
 Type of Design Alternatives ..... Mutually Exclusive  
 Length of Analysis ..... 20 yrs  
 Discount Rate ..... 4.50 %

#### 1A. Summary of Results

Base Case <b>[Winner]</b>	Geothermal [Geothermal]
Challenger	Original Design Base Case [Base Case]
[Geothermal] Total Present Worth (\$)	\$4,275,799
[Base Case] Total Present Worth (\$)	\$5,116,437
Net Present Worth Savings (\$)	\$-840,638
Savings-To-Investment Ratio (SIR)	-0.029
Payback Period (yrs)	n/a

#### 1B. Comparative Analysis Details

Year	Date	Cash Flow (Present Worth \$)			SIR and Payback Calculation (Present Worth \$)				
		[Geothermal] Cash Flow (\$)	[Base Case] Cash Flow (\$)	Net Present Worth Savings (\$)	Operating Cost Savings (\$)	Cumulative Operating Cost Savings (\$)	Additional Investment Cost (\$)	Cumulative Additional Investment Cost (\$)	Year-End SIR
0	Initial	1,817,223	2,634,229	-817,006	0	0	817,006	817,006	0.000
1	1	135,677	136,981	-1,304	-1,304	-1,304	0	817,006	-0.002
2	2	134,248	135,539	-1,290	-1,290	-2,595	0	817,006	-0.003
3	3	132,835	134,112	-1,277	-1,277	-3,871	0	817,006	-0.005
4	4	131,437	132,700	-1,263	-1,263	-5,135	0	817,006	-0.006
5	5	130,054	131,304	-1,250	-1,250	-6,385	0	817,006	-0.008
6	6	128,685	129,921	-1,237	-1,237	-7,622	0	817,006	-0.009
7	7	127,330	128,554	-1,224	-1,224	-8,846	0	817,006	-0.011
8	8	125,990	127,201	-1,211	-1,211	-10,057	0	817,006	-0.012
9	9	124,663	125,862	-1,198	-1,198	-11,255	0	817,006	-0.014
10	10	123,351	124,537	-1,186	-1,186	-12,441	0	817,006	-0.015
11	11	122,053	123,226	-1,173	-1,173	-13,614	0	817,006	-0.017
12	12	120,768	121,929	-1,161	-1,161	-14,775	0	817,006	-0.018
13	13	119,497	120,645	-1,149	-1,149	-15,923	0	817,006	-0.019
14	14	118,239	119,375	-1,137	-1,137	-17,060	0	817,006	-0.021
15	15	116,994	118,119	-1,125	-1,125	-18,184	0	817,006	-0.022
16	16	115,763	116,875	-1,113	-1,113	-19,297	0	817,006	-0.024
17	17	114,544	115,645	-1,101	-1,101	-20,398	0	817,006	-0.025
18	18	113,338	114,428	-1,089	-1,089	-21,487	0	817,006	-0.026
19	19	112,145	113,223	-1,078	-1,078	-22,565	0	817,006	-0.028
20	20	110,965	112,032	-1,067	-1,067	-23,632	0	817,006	-0.029
Totals		4,275,799	5,116,437	-840,638	-23,632		817,006		

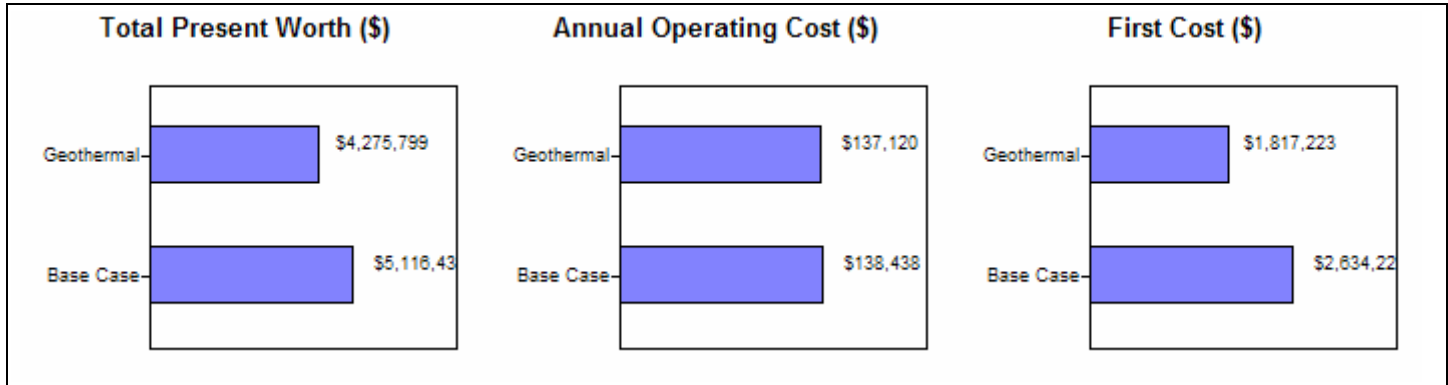
# Lifecycle Summary

Project: Student Services Building  
 Prepared By: The Pennsylvania State University

4/10/2006  
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## Geothermal Economics

Type of Analysis ..... Public Sector Lifecycle Analysis  
 Type of Design Alternatives ..... Mutually Exclusive  
 Length of Analysis ..... 20 yrs  
 Discount Rate ..... 4.50 %



**Table 1. Executive Summary**

Economic Criteria	Best Design Case for Each Criteria	Value (\$)
Incremental SIR Analysis	Geothermal	-
Lowest Total Present Worth	Geothermal	\$4,275,799
Lowest Annual Operating Cost	Geothermal	\$137,120
Lowest First Cost	Geothermal	\$1,817,223

**Table 2. Design Cases Ranked by First Cost**

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Geothermal	Geothermal	\$4,275,799	\$137,120	\$1,817,223
Original Design Base Case	Base Case	\$5,116,437	\$138,438	\$2,634,229

**Table 3. Incremental Analysis Data**

Challenger	Base Case	Additional First Cost (\$)	NPW Savings (\$)	SIR	Payback Period (yrs)
Base Case	Geothermal [Winner]	\$817,006	\$-840,638	-0.029	n/a

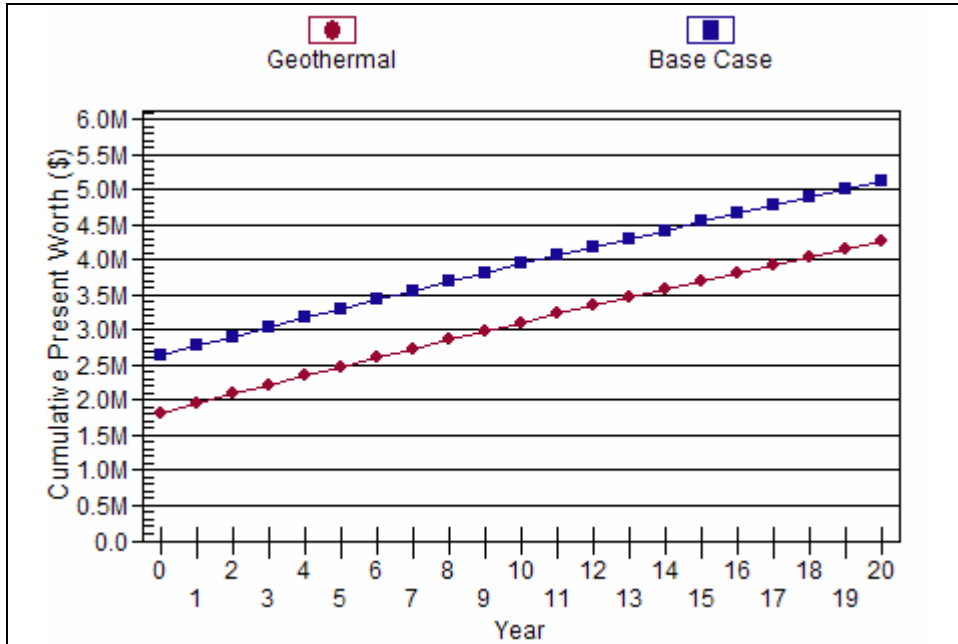
# Total Present Worth Profiles

Project: Student Services Building  
 Prepared By: The Pennsylvania State University

4/10/2006  
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## Geothermal Economics

Type of Analysis ..... Public Sector Lifecycle Analysis  
 Type of Design Alternatives ..... Mutually Exclusive  
 Length of Analysis ..... 20 yrs  
 Discount Rate ..... 4.50 %



### Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Geothermal	Geothermal	\$4,275,799	\$137,120	\$1,817,223
Original Design Base Case	Base Case	\$5,116,437	\$138,438	\$2,634,229

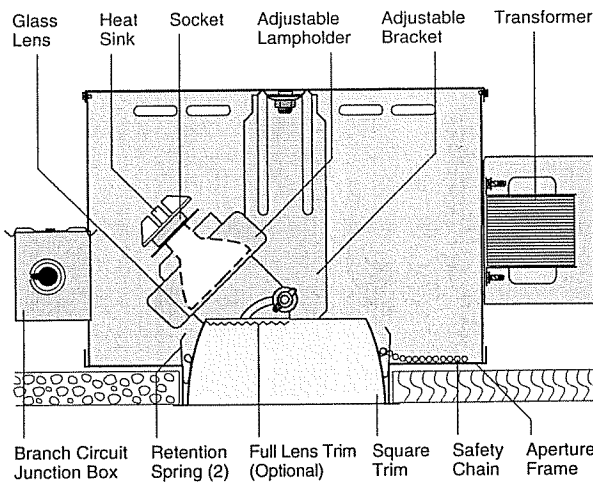
FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	WATTAGE PER LAMP	NO OF LAMPS PER FIXTURE	NO OF FIXTURES	WATTS	POWER DENSITY WSQFT
1st	100	ATRIUM / LOWER LOBBY	2,000	VARIES	VARIES	VARIES	1250	0.625
1st	101	FAMILY TOILET	48	32	2	1	64	1.333
1st	102	ELEV MACHINE ROOM	100	32	2	2	128	1.280
1st	103	HOUSE KEEPING	100	32	2	2	128	1.280
1st	104	HOUSE KEEPING OFFICE	142	32	2	2	128	0.901
1st	105	MECHANICAL	410	32	2	6	384	0.937
1st	106	STORAGE	1,440	32	3	11	1056	0.733
1st	107	OFFICE SUPPORT WORK AREA	1,125	32	3	14	1344	1.195
1st	108	RECEPTON	200	32	2	4	256	1.280
1st	109	ASSISTANT OFFICE	140	32	2	3	192	1.371
1st	110	MANAGER OFFICE	140	32	2	3	192	1.371
1st	111	DIRECTOR OFFICE	150	32	2	3	192	1.280
1st	112	CASH HANDLING WORK ROOM	250	32	2	4	256	1.024
1st	112A	CLOSET	20	0	0	0	0	0.000
1st	113	BOOKSTORE MERCHANDISING AREA	3,596	VARIES	VARIES	VARIES	3880	1.079
1st	114	WELCOME CENTER RECEPTION	230	VARIES	VARIES	VARIES	840	3.652
1st	115	CALL CENTER	100	32	2	2	128	1.280
1st	116	SHARED OFFICE	595	32	2	11	704	1.183
1st	116A	OFFICE STORAGE	100	32	3	2	192	1.920
1st	117	SECURITY RECEPTION	150	32	2	3	192	1.280
1st	118	ID OFFICE	170	32	2	3	192	1.129
1st	119	DIRECTOR OFFICE	150	32	2	2	128	0.853
1st	119A	STORAGE	100	32	3	2	192	1.920
1st	R11	WOMEN TOILET ROOM	350	32	2	12	768	2.194
1st	R12	MEN TOILET ROOM	350	32	2	12	768	2.194
1st	E11	ELECTRICAL CLOSET	40	32	2	1	64	1.600
1st	T11	TELECOM & AV	40	32	2	1	64	1.600
1st	V11	VESTIBULE	190	32	1	4	128	0.674
1st	C11	CORRIDOR	55	32	3	1	96	1.745
1st	C12	CORRIDOR	1,025	32	3	8	768	0.749
1st	C13	CORRIDOR	500	32	3	4	384	0.768
1st	C14	CORRIDOR	545	32	3	5	480	0.881
1st	C15	CORRIDOR	500	32	3	3	288	0.576
1st	C16	CORRIDOR	175	32	3	2	192	1.097
1st	120	MAIN DINING HALL	5730	VARIES	VARIES	VARIES	4250	0.742
1st	120A	HOUSE KEEPING CLOSET	37	32	2	1	64	1.730
1st	121	FOOD SERVING AREA	2395	VARIES	VARIES	VARIES	2845	1.188
1st	122	KITCHEN	1045	32	3	12	1152	1.102
1st	123	FOOD SERVICE OFFICE	135	32	3	2	192	1.422
1st	124	DRY STORAGE	520	32	3	6	576	1.108
1st	125	PRIVATE RESTROOM	42	32	2	1	64	1.524
1st	126	HOUSEKEEPING STORAGE	35	32	2	1	64	1.829
1st	127	CATERING STORAGE	250	32	3	3	288	1.152
1st	128	CENTRAL TRASH	140	32	3	2	192	1.371
1st	L11	LOADING DOCK	525	17	2	6	204	0.389
1st	T12	TELECOM & AV	50	32	2	1	64	1.280
1st	E12	ELECTRICAL CLOSET	50	32	2	1	64	1.280
			26,180					
2nd	200	VENDING ALCOVE	100	32	2	1	64	0.640
2nd	200A	JANITORS CLOSET	60	32	2	1	64	1.067
2nd	201	FINANCE RECEPTION	300	32	2	7	448	1.493
2nd	C201	CORRIDOR	1450	32	1	18	576	0.397
2nd	202	OFFICE SUPPORT WORK AREA	495	VARIES	VARIES	VARIES	816	1.648
2nd	C202N	CORRIDOR	110	40	2	2	160	1.455
2nd	203	AR/CR OFFICE 2	135	32	2	2	128	0.948
2nd	C203	CORRIDOR	480	40	2	3	240	0.500
2nd	204	AR/CR OFFICE 1	135	32	2	2	128	0.948
2nd	C204	CORRIDOR	545	40	2	8	640	1.174
2nd	205	ASSOCIATE DIRECTOR 1	135	32	2	2	128	0.948
2nd	C205	CORRIDOR	210	40	2	3	240	1.143
2nd	206	ADMINISTRATIVE	135	32	2	2	128	0.948
2nd	C206	CORRIDOR	140	40	2	3	240	1.714
2nd	207	SHARED OFFICE ACCOUNTS PAYABLE	415	32	2	6	384	0.925
2nd	208	ASSOCIATE DIRECTOR 2	135	32	2	2	128	0.948
2nd	209	ASSOCIATE DIRECTOR 3	135	32	2	2	128	0.948

FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	WATTAGE PER LAMP	NO OF LAMPS PER FIXTURE	NO OF FIXTURES	WATTS	POWER DENSITY WSQFT
2nd	210	ADMIN OFFICE 2	135	32	2	2	128	0.948
2nd	211	SHARED OFFICE PAYROLL	420	32	2	6	384	0.914
2nd	212	CASHIERS	485	VARIES	VARIES	VARIES	560	1.155
2nd	213	SUPERVISOR OFFICE	135	32	2	2	128	0.948
2nd	214	AR/CR SHARED OFFICE	290	32	2	8	512	1.766
2nd	215	STORAGE/ FILE ROOM	400	32	3	5	480	1.200
2nd	216	CASH HANDLING WORK ROOM	250	32	2	6	384	1.536
2nd	217	ASSOCIATE DIRECTOR 4	135	32	2	2	128	0.948
2nd	218	STORAGE ROOM	485	32	3	5	480	0.990
2nd	219	DIRECTOR OFFICE	150	32	2	2	128	0.853
2nd	220	AUDITOR'S CONFERENCE ROOM	275	32	2	4	256	0.931
2nd	221	CONFERENCE ROOM	280	VARIES	VARIES	VARIES	534	1.907
2nd	222	FINANCIAL AND RECEPTION	810	VARIES	VARIES	VARIES	1496	1.847
2nd	223	SUPERVISOR OFFICE	105	32	2	2	128	1.219
2nd	224	COUNSELING OFFICE 4	105	32	2	2	128	1.219
2nd	225	COUNSELING OFFICE 3	135	32	2	2	128	0.948
2nd	226	COUNSELING OFFICE 2	135	32	2	2	128	0.948
2nd	227	COUNSELING OFFICE 1	135	32	2	2	128	0.948
2nd	228	OFFICE SUPPORT WORK AREA	300	32	3	3	288	0.960
2nd	228A	STORAGE / FILE AREA	160	32	3	2	192	1.200
2nd	229	ASSOCIATE DIRECTOR	135	32	2	2	128	0.948
2nd	230	DIRECTOR OFFICE	150	32	2	2	128	0.853
2nd	231	ASSISTANT DIRECTOR	135	32	2	2	128	0.948
2nd	T21	TELECOM & AV ROOM	75	32	2	2	128	1.707
2nd	E21	ELECTRICAL CLOSET	53	32	2	1	64	1.208
2nd	R21	WOMEN TOILET ROOM	235	32	2	12	768	3.268
2nd	R22	MEN TOILET ROOM	225	32	2	12	768	3.413
2nd	V21	VESTIBULE	110	32	1	2	64	0.582
2nd	232	CONFERENCE ROOM 2	630	VARIES	VARIES	VARIES	1524	2.419
2nd	233	RECORDS & REGISTRATION RECEPTION	880	32	2	20	1280	1.455
2nd	234	OFFICE SUPPORT WORK AREA	240	32	2	4	256	1.067
2nd	235	RECORD ROOM & STORAGE	400	32	3	5	480	1.200
2nd	236	REC SPECIALIST 2	135	32	2	2	128	0.948
2nd	237	REC SPECIALIST 1	135	32	2	2	128	0.948
2nd	238	ASSISTANT DIRECTOR 3	135	32	2	2	128	0.948
2nd	239	ASSISTANT DIRECTOR 2	135	32	2	2	128	0.948
2nd	240	ASSISTANT DIRECTOR 1	135	32	2	2	128	0.948
2nd	241	DIRECTOR OFFICE	150	VARIES	VARIES	VARIES	192	1.280
2nd	242	ADMISSIONS & ADVISING RECEPT	550	32	2	15	960	1.745
2nd	243	TRANSFER CENTER LAB	1590	32	2	25	1600	1.006
2nd	243A	VISITING TRANSFER REP	130	32	2	2	128	0.985
2nd	243B	TRANSFER ASSISTANT	130	32	2	2	128	0.985
2nd	244	OFFICE SUPPORT WORK AREA	300	VARIES	VARIES	VARIES	736	2.453
2nd	245	WAITING & STUDENT WORK AREA	840	32	2	12	768	0.914
2nd	246	INFORMATION SPECIALIST	515	32	2	9	576	1.118
2nd	247	OFFICE SUPERVISOR	135	32	2	2	128	0.948
2nd	248	DIRECTOR OFFICE	150	32	2	2	128	0.853
2nd	249	ADVISING OFFICE 12	135	32	2	2	128	0.948
2nd	250	ADVISING OFFICE 11	135	32	2	2	128	0.948
2nd	251	ADVISING OFFICE 10	135	32	2	2	128	0.948
2nd	252	ADVISING OFFICE 9	135	32	2	2	128	0.948
2nd	253	ADVISING OFFICE 8	135	32	2	2	128	0.948
2nd	254	ADVISING OFFICE 7	135	32	2	2	128	0.948
2nd	255	ADVISING OFFICE 6	135	32	2	2	128	0.948
2nd	256	ADVISING OFFICE 5	135	32	2	2	128	0.948
2nd	257	OFFICE SUPPORT STORAGE	205	32	3	2	192	0.937
2nd	258	RECORD ROOM	210	32	3	2	192	0.914
2nd	259	ADVISING OFFICE 4	135	32	2	2	128	0.948
2nd	260	ADVISING OFFICE 3	135	32	2	2	128	0.948
2nd	261	ASSOCIATE DIRECTOR 5	135	32	2	2	128	0.948
2nd	262	ASSOCIATE DIRECTOR 4	135	32	2	2	128	0.948
2nd	263	ASSOCIATE DIRECTOR 3	135	32	2	2	128	0.948
2nd	264	ADVISING OFFICE 2	125	32	2	2	128	1.024
2nd	265	TRANSCRIPT EVALUATOR 2	135	32	2	2	128	0.948
2nd	266	ASSOCIATE DIRECTOR 2	135	32	2	2	128	0.948
2nd	267	TRANSCRIPT EVALUATOR 1	135	32	2	2	128	0.948

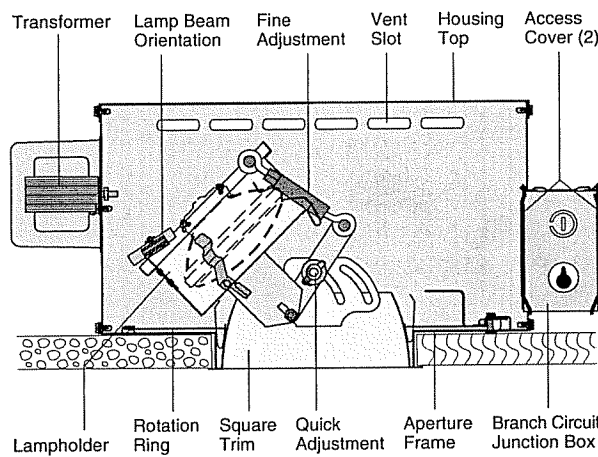


FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	WATTAGE PER LAMP	NO OF LAMPS PER FIXTURE	NO OF FIXTURES	WATTS	POWER DENSITY WSQFT
2nd	268	ASSOCIATE DIRECTOR 1	135	32	2	2	128	0.948
2nd	269	ADVISING OFFICE 1	125	32	2	2	128	1.024
2nd	C202S	CORRIDOR	815	32	1	17	544	0.667
2nd	C207	CORRIDOR	0	0	0	0	0	0.000
2nd	C208	CORRIDOR	360	40	2	6	480	1.333
2nd	C209	CORRIDOR	1140	40	2	19	1520	1.333
2nd	C210	CORRIDOR	170	40	2	3	240	1.412
2nd	E22	ELECTRICAL CLOSET	50	32	2	2	128	2.560
2nd	T22	TELECOM & AV ROOM	50	32	2	1	64	1.280
			24418					
3rd	300	VENDING ALCOVE	100	32	2	3	192	1.920
3rd	300A	JANITORS CLOSET	20	32	2	1	64	3.200
3rd	301	FAMILY TOILET	63	32	2	1	64	1.016
3rd	302	ACADEMIC SUPPORT, CAREER & COUNCIL	400	32	2	9	576	1.440
3rd	302A	WAITING	230	32	2	6	384	1.670
3rd	303	OFFICE SUPPORT WORK AREA	378	VARIES	VARIES	VARIES	576	1.524
3rd	304	CAREER SERVICE LIBRARY COMPUTERS	1120	32	2	16	1024	0.914
3rd	304A	LAB RECEPTION	128	32	2	1	64	0.500
3rd	304B	CAREER SERVICE LIBRARY COMPUTERS	682	32	2	6	384	0.563
3rd	305	CAREER SERVICE COMPUTER LAB	990	32	2	18	1152	1.164
3rd	305A	RECORDS ROOM / STORAGE	105	32	3	1	96	0.914
3rd	306	ASSISTANT DIRECTOR 1	135	32	2	2	128	0.948
3rd	307	ASSISTANT DIRECTOR 2	135	32	2	2	128	0.948
3rd	308	ADMIN 1	135	32	2	2	128	0.948
3rd	309	ADMIN 2	135	32	2	2	128	0.948
3rd	310	ADMIN 3	135	32	2	2	128	0.948
3rd	311	ADMIN 4	135	32	2	2	128	0.948
3rd	312	ADMIN 5	135	32	2	2	128	0.948
3rd	313	ADMIN 6	135	32	2	2	128	0.948
3rd	314	ADMIN 7	135	32	2	2	128	0.948
3rd	315	ASSISTANT DIRECTOR 3	135	32	2	2	128	0.948
3rd	316	RECORDS ROOM / STORAGE	132	32	3	2	192	1.455
3rd	317	ADMIN 8	135	32	2	2	128	0.948
3rd	318	ADMIN 9	135	32	2	2	128	0.948
3rd	319	ASSISTANT DIRECTOR 4	135	32	2	2	128	0.948
3rd	320	ASSISTANT DIRECTOR 5	135	32	2	2	128	0.948
3rd	321	ADMIN 10	135	32	2	2	128	0.948
3rd	322	ADMIN 11	135	32	2	2	128	0.948
3rd	323	ADMIN 12	135	32	2	2	128	0.948
3rd	324	ADMIN 13	135	32	2	2	128	0.948
3rd	325	ADMIN 14	135	32	2	2	128	0.948
3rd	326	ADMIN 15	135	32	2	2	128	0.948
3rd	327	ADMIN 16	135	32	2	2	128	0.948
3rd	328	ADMIN 17	135	32	2	2	128	0.948
3rd	329	ADMIN 21	135	32	2	2	128	0.948
3rd	330	ASSISTANT DIRECTOR 6	135	32	2	2	128	0.948
3rd	331	ASSISTANT DIRECTOR 7	135	32	2	2	128	0.948
3rd	332	ASSISTANT DIRECTOR 8	135	32	2	2	128	0.948
3rd	333	DIRECTOR OFFICE	150	32	2	2	128	0.853
3rd	334	CONFERENCE ROOM 3	390	VARIES	VARIES	VARIES	534	1.369
3rd	335	ADMIN 20	135	32	2	2	128	0.948
3rd	336	ADMIN 19	135	32	2	2	128	0.948
3rd	337	ADMIN 18	135	32	2	2	128	0.948
3rd	338	RECORDS ROOM STORAGE	135	32	2	2	128	0.948
3rd	T31	TELECOM & AV	60	32	2	2	128	2.133
3rd	E31	ELECTRICAL CLOSET	45	32	2	1	64	1.422
3rd	C301	CORRIDOR	800	VARIES	VARIES	VARIES	992	1.240
3rd	C301A	CORRIDOR	560	32	1	6	192	0.343
3rd	C302	CORRIDOR	800	32	1	16	512	0.640
3rd	C303	CORRIDOR	850	40	2	16	1280	1.506
3rd	C304	CORRIDOR	220	40	2	4	320	1.455
3rd	C305	CORRIDOR	220	40	2	4	320	1.455
3rd	C306	CORRIDOR	220	40	2	4	320	1.455
3rd	C307	CORRIDOR	360	40	2	6	480	1.333
3rd	R31	WOMEN TOILET ROOM	230	32	2	12	768	3.339

FLOOR	ROOM #	SPACE DESCRIPTION	AREA (sqft)	WATTAGE PER LAMP	NO OF LAMPS PER FIXTURE	NO OF FIXTURES	WATTS	POWER DENSITY W/SQFT
3rd	R32	MEN TOILET ROOM	225	32	2	12	768	3.413
3rd	339	CONFERENCE ROOM 4	625	VARIES	VARIES	VARIES	1524	2.438
3rd	340	RECEPTION	540	32	2	12	768	1.422
3rd	341	OFFICE SUPPORT WORK AREA	255	32	2	3	192	0.753
3rd	342	STORAGE	225	32	3	2	192	0.853
3rd	343	ADAPTIVE LAB	283	32	2	6	384	1.357
3rd	344	ADMIN 22	135	32	2	2	128	0.948
3rd	345	LAB RECEPTION	150	32	2	2	128	0.853
3rd	346	LAC COMPUTER LAB	925	32	2	20	1280	1.384
3rd	347	LARGE TUTORING LAB	1980	32	2	32	2048	1.034
3rd	348	ADMIN 23	125	32	2	2	128	1.024
3rd	349	ADMIN 24	135	32	2	2	128	0.948
3rd	350	ADMIN 25	135	32	2	2	128	0.948
3rd	351	ASSISTANT DIRECTOR 9	135	32	2	2	128	0.948
3rd	352	LAC WRITE LAB	330	32	2	5	320	0.970
3rd	353	ASSISTANT DIRECTOR 10	135	32	2	2	128	0.948
3rd	354	SMALL TUTORING 1	140	32	2	2	128	0.914
3rd	355	SMALL TUTORING 2	140	32	2	2	128	0.914
3rd	356	SMALL TUTORING 3	140	32	2	2	128	0.914
3rd	357	SMALL TUTORING 4	140	32	2	2	128	0.914
3rd	358	ASSISTANT DIRECTOR 11	140	32	2	2	128	0.914
3rd	359	TEST CENTER RECEPTION	335	32	2	9	576	1.719
3rd	360	LARGE TESTING ROOM	1580	VARIES	VARIES	VARIES	1976	1.251
3rd	361	TEST CENTER COORDINATOR	140	32	2	2	128	0.914
3rd	362	STORAGE	370	32	3	4	384	1.038
3rd	363	TOILET	42	32	2	1	64	1.524
3rd	364	TOILET	42	32	2	1	64	1.524
3rd	365	OFFICE SUPPORT WORK AREA	125	32	2	2	128	1.024
3rd	366	TEST CENTER RECEPTION	330	32	2	9	576	1.745
3rd	367	COMPUTER PLACEMENT TESTING ROOM	900	32	2	18	1152	1.280
3rd	368	PROMETRIC TESTING ROOM	415	32	2	10	640	1.542
3rd	369	READER/ WRITER TESTING ROOM	135	32	2	2	128	0.948
3rd	370	READER/ WRITER TESTING ROOM	135	32	2	2	128	0.948
3rd	E32	ELECTRICAL CLOSET	50	32	2	1	64	1.280
3rd	T32	TELECOM & AV	50	32	2	1	64	1.280
3rd	C309	CORRIDOR	400	40	2	4	320	0.800
3rd	C310	CORRIDOR	380	40	2	7	560	1.474
			25770					
4th	400	PRIVATE DINING ROOM 1	2988	50	1	63	3150	1.054
4th	400A	TERRACE	1385	VARIES	VARIES	VARIES	936	0.676
4th	401	PRIVATE DINING ROOM 2	1360	50	1	24	1200	0.882
4th	402	PANTRY	340	32	3	4	384	1.129
4th	403	STORAGE	320	32	3	3	288	0.900
4th	C402A	JANITORS CLOSET	40	32	2	1	64	1.600
4th	C400	CORRIDOR	809	32	2	10	640	0.791
4th	C401	CORRIDOR	1350	VARIES	VARIES	VARIES	2052	1.520
4th	C402	CORRIDOR	185	32	1	4	128	0.692
4th	R41	WOMEN TOILET ROOM	245	32	2	8	512	2.090
4th	R42	MEN TOILET ROOM	198	32	2	9	576	2.909
4th	E41	ELECTRICAL CLOSET	40	32	2	1	64	1.600
			9260					
			90,280					
			TOTAL (sqft)				TOTAL (Watts)	OVERALL (W/sqft)
		TOTALS	90,280				98243	1.088

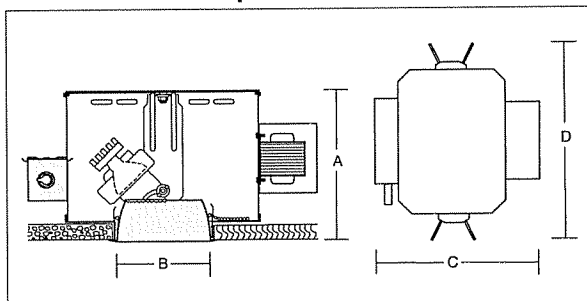


**H8416**



**H8436**

**Dimensions and Lamps**



Number	A Depth	B Aperture	C Width	D Length	Lamps
H8416	7 3/4" 197mm	4 1/2" sq. 114mm	15 3/4" 400mm	19" 483mm	20-75W MR-16 Low voltage
H8436	8 3/4" 223mm	4 1/2" sq. 114mm	18 1/2" 470mm	18 1/2" 463mm	12V or 5.5V 25-75W PAR-36 35-75W AR111

**Matching Square Units \***

- 6" aperture PAR-36, AR111      Page H6
- Directional downlights      Pages H2, H24
- Compact fluorescent      Page H21
- Tungsten halogen      Page H4
- Metal halide      Pages H24, H25
- Wall washer      Page H32

**H8416 MR-16 Lamps**

**H8436 PAR-36, AR111 Low Voltage Lamps**

**Directional Downlights**  
4 1/2" Square Parabolic Trim

**Optics and Applications**

The variety of low voltage lamps offer beam spreads from 4° to 55°. A glass lens is standard only for H8416. Ideal for highlighting merchandise, art objects and other points of interest. Suitable for damp locations.

**Design Features**

The lampholder assemblies rotate 360°. H8416 tilts 45°, H8436 tilts 40°. Both lock in any selected position. They accept two optional accessories. Steel housings protect all internal components and are vented for air flow cooling. The trims are stabilized to prevent racking. They are held to the ceiling by constant pressure stainless steel springs. Maximum ceiling thickness 7/8". Top or bottom service.

**Finish**

Housings and structural parts are painted matte black to suppress stray light leaks. Standard trims are anodized Softglow® clear. Special finishes, textures and colors are available, see below under Accessories.

**Transformers**

Each fixture is supplied with a transformer capable of accommodating low voltage lamps up to 75W. The primary lead is 120V with a 12V secondary. The transformers are rated 180°C, Class H with a built-in 150° resetting thermal link fuse. They can be lowered through the aperture for service. Maximum fixture draw is 85W.

**Trim Textures**

Select among different embossed patterns to match the ambience of the space being illuminated. Refer to Squares brochure for descriptive photos.

**General**

Fixtures are pre-wired, thermally protected, UL and C-UL listed for eight wire 75°C branch circuit wiring. All products are union made IBEW. Luminaire Efficiency Ratings (LER) do not apply to directional fixtures.

**Accessories**

- R2 26" support rails.      WT White trim flange.
  - R5 52" support rails.      WHT White complete trim.
  - SB Softglow black.      BP Ball Peen texture.
  - SG Softglow gold.      CG Corrugated texture.
  - SH Softglow mocha.      DS Distressed texture.
  - SP Softglow graphite.      WV Woven texture.
  - ST Softglow titanium.      HL Hexcell louver.
  - SW Softglow wheat.      HD Hood, MR-16.
  - SY Softglow pewter.      LL Linear spread lens.
  - SZ Softglow bronze.      LP Large prism lens.
  - BR Bright trim finish.      MP Microprism lens.
  - DP Fixed downlight position.
  - FR Frosted lens, specify lens type.
  - TAL Turn and Lock MR-16 lamp.
  - V277 277 volt primary transformer.
  - AR70 Aluminum reflector lamp, specify H8470.
  - FLT4 Full lens trim, specify lens type, e.g. H8416-FLT4LL.
  - WRL Wattage restriction label, specify wattage.
- For color filters, pattern control lenses, light block screens, UV filters and other accessories, contact the factory.

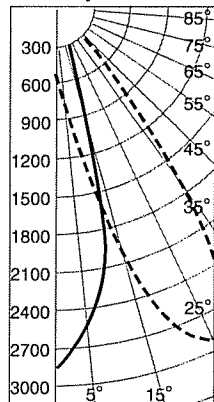
# H1 H8416 H8436

## Footcandle Values at Nadir

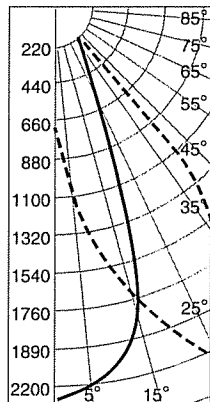
Distance	5'			10'			15'			20'		
	Nadir	10°	15°	Nadir	10°	15°	Nadir	10°	15°	Nadir	10°	15°
Lamps	FC	FC Diam	FC Diam	FC	FC Diam	FC Diam	FC	FC Diam	FC Diam	FC	FC Diam	FC Diam
H8416 50W MR-16/NFL/25°	115	78 2'	39 3'	29	20 4'	10 5'	13	9 5'	4 8'	7	5 7'	2 11'
H8416 75W MR-16/FL/40°	93	81 2'	62 3'	23	20 4'	16 5'	10	9 5'	7 8'	6	5 7'	4 11'
H8416 50W MR-16/NSP/15°	370	94 2'	31 3'	93	24 4'	8 5'	41	11 5'	4 8'	23	6 7'	2 11'
H8416 75W MR-16/NSP/15°	447	32 2'	16 3'	112	8 4'	4 5'	50	4 5'	2 8'	28	2 7'	1 11'

Distance	10'			15'			20'			25'		
	Nadir	10°	15°	Nadir	10°	15°	Nadir	10°	15°	Nadir	10°	15°
Lamps	FC	FC Diam	FC Diam	FC	FC Diam	FC Diam	FC	FC Diam	FC Diam	FC	FC Diam	FC Diam
H8436 50W PAR-36/WFL/40°	11	9 4'	6 5'	5	4 5'	3 8'	3	2 7'	2 11'	2	1 9'	1 13'
H8436 75W AR111/FL/25°	43	28 4'	8 5'	19	12 5'	4 8'	11	7 7'	2 11'	7	4 9'	1 13'
H8436 50W PAR-36/NSP/10°	83	31 4'	5 5'	37	14 5'	2 8'	21	8 7'	1 11'	13	5 9'	1 13'
H8436 75W AR111/SP/8°	243	8 4'	1 5'	108	3 5'	0 8'	61	2 7'	0 11'	39	1 9'	0 13'

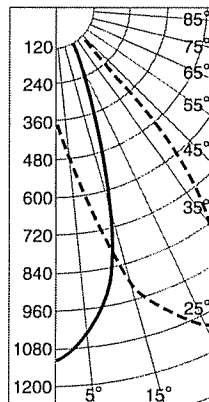
## Candlepower Distribution



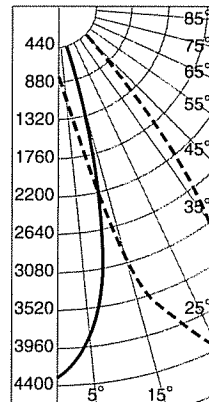
H8416 50W MR-16/NFL EXZ 25°



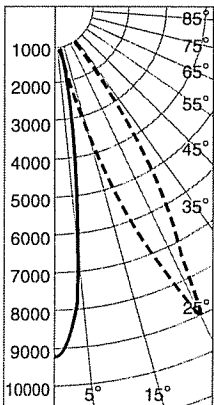
H8416 75W MR-16/NFL EYC 40°



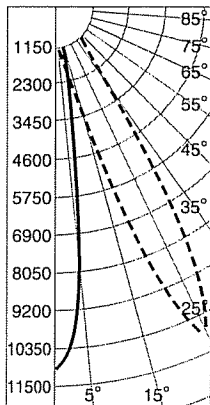
H8436 50W PAR-36 WFL 40°



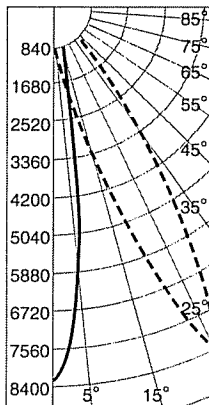
H8436 75W AR111 FL 25°



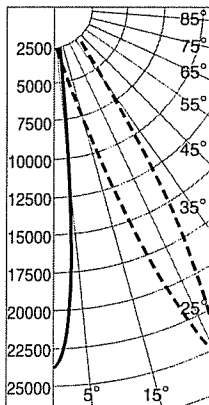
H8416 50W MR-16/NSP EXT 15°



H8416 75W MR-16/NSP EYF 15°



H8436 50W PAR-36/NSP 10°



H8436 75W AR111/SP 8°

## Candelas at Nadir

°	50W	75W	50W	75W
	3400*	2100*	900*	5300*
0	2875	2330	1119	4279
5	2610	2218	1009	3860
10	2050	2115	911	2928
15	1090	1722	667	918
20	400	898	365	343
25	118	260	180	46
30	10	105	65	18
35	0	56	11	0
40	0	14	0	0
45	0	3	0	0
50	0	0	0	0
55	0	0	0	0
60	0	0	0	0
65	0	0	0	0
70	0	0	0	0
75	0	0	0	0
80	0	0	0	0
85	0	0	0	0
90	0	0	0	0

° Vertical Angles  
\* CBCP

°	50W	75W	50W	75W
	10200*	12000*	11000*	30000*
0	9250	11179	8298	24317
5	6425	6250	5611	11512
10	2471	825	3248	792
15	865	450	600	107
20	150	89	66	23
25	26	14	49	0
30	0	0	9	0
35	0	0	0	0
40	0	0	0	0
45	0	0	0	0
50	0	0	0	0
55	0	0	0	0
60	0	0	0	0
65	0	0	0	0
70	0	0	0	0
75	0	0	0	0
80	0	0	0	0
85	0	0	0	0
90	0	0	0	0

° Vertical Angles  
\* CBCP

## Notes

- All data with standard trim, Softglow® clear.
- Candlepower distribution curves: solid lines show horizontal distribution at nadir, dotted lines show horizontal distribution at 25° lamp tilt.
- Pattern diameters are determined from each side of nadir with 0° lamp tilt. The diameter includes both sides, so a 10° diameter represents a total 20° pattern width at the floor. Footcandles are measured at the diameter edge. Tilting the lamp changes all data.

## Brightness

Number	Lamps	85°	75°	65°	55°	45°
H8416	50W MR-16 EXZ	7	29	45	77	145
	75W MR-16 EYC	12	38	64	109	216
	75W MR-16 EYF	4	21	35	54	105
H8436	75W AR111 FL	4	15	26	58	139
	75W AR111 SP	3	12	19	40	88

[Return to: TRU-AIM IR® MR16](#)

[Print Page](#)



**Product Number:** 54173  
**Order Abbreviation:** 50MR16/IR/FL40/C 12V  
**General Description:** Tungsten Halogen Tru-Aim MR16 IR UV-Stop Capsule With Axial Filament, Hard Dichroic Reflector GU5.3 Bi-Pin Base 50Watt 12Volt Flood Beam

**Product Information**

Abbrev. With Packaging Info.	50MR16IRFL40C 12V 20/CS 1/SKU
Average Rated Life (hr)	4000
Base	GU5.3 Bipin
Beam Angle (deg)	40
Beam Type	FL
Bulb	MR16
Centerbeam Candlepower (cp)	2850
Class	C (gas)
Color Rendering Index (CRI)	100
Color Temperature/CCT (K)	3000
Diameter (in)	2
Diameter (mm)	50.8
Ecologic	YES
Family Brand Name	TRU-AIM® IR
Filament	AXIAL
Horizontal Beam Angle (deg)	40
Maximum Overall Length - MOL (in)	1.75
Maximum Overall Length - MOL (mm)	44.45
Nominal Voltage (V)	12.00
Nominal Wattage (W)	50.00
Vertical Beam Angle (deg)	40

**Additional Product Information**

[Product Documents, Graphs, and Images](#)

[Packaging Information](#)



**Footnotes**

- UV Filter capsule with axial filament in constant color, hard coated Dichroic reflector and infrared reflective coating on the lamp capsule.
- Infrared lamp technology
- Max. seal temperature 350 C (662F)
- Max pin temperature 250 C.
- Max temperature at lens reflector joint 240 C.

[Print Page](#)

# FEATURES

## OPTICAL

- Reflector – Self-flanged, specular clear or semi-diffuse reflector. Bounding Ray Optical Principle design provides lamp before lamp image and smooth transition from top of reflector to bottom. Minimum flange matches reflector finish. White painted flange optional. (Vertisys optical system patented – US Patent #5,800,050)
- Baffle– Specular clear upper reflector. Microgroove baffle with white painted flange.

## MECHANICAL

- 16-gauge galvanized steel mounting/plaster frame with friction support springs to retain optical system. Accommodates up to 7/8" thick ceiling standard. See Accessories for increased ceiling thickness capability.
- Mounting bars are 16-gauge galvanized steel with continuous 4" vertical adjustment, held in place with tool-less, cam-action locking system. Post installation adjustment possible without the use of tools from above or below the ceiling. Shipped pre-installed.
- Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination 1/2"-3/4" and three 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

## ELECTRICAL SYSTEM

- Rugged aluminum lampholder housing designed for positive lamp positioning.
- Vertically mounted, positive-latch thermoplastic socket.
- Class P, thermally-protected, high power factor ballast mounted to the junction box.

## LISTING

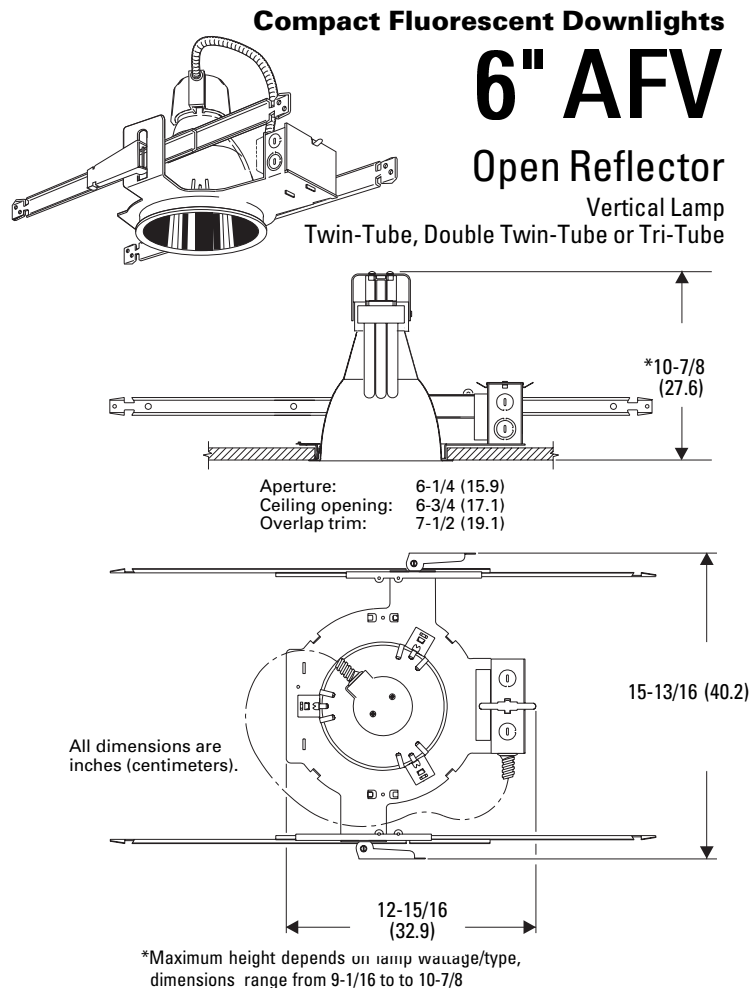
- Fixtures are UL Listed for thru-branch wiring, recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards (see Options).

# ENERGY

LER.DOH	Annual Energy Cost	Lamps	Lamp Lumens	Ballast Factor	Input Watts
40	\$6.02	(1)26TRT	1800	.98	27

Calculated in accordance with NEMA standard LE-5.

Type Catalog number



# ORDERING INFORMATION

Example: **AFV 1/26DTT 6AR 120 GEB10 WLP**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog numbers (shipped separately).

## AFV

Series	Wattage/lamp	Reflector Type	Lens Type	Ballast <sup>6</sup>	Options
AFV	9TT <sup>1</sup> One 9W twin-tube	6AR Clear	(blank) no lens	EMB Electromagnetic ballast.	WLP With 35°K lamp (shipped separately).
	13TT <sup>1</sup> One 13W twin-tube	6PR Pewter	CGL Safety glass (w/lamp-holder for enclosed metal halide lamp).	GEB10 Electronic ballast.	TRW White painted flange (standard on 6MB). 6WR and 6WB.
	13DTT One 13W double twin-tube	6UBR Umber	CAL Clear acrylic lens	DMHL Lutron Hi-lume <sup>®</sup> electronic dimming ballast, 120V or 277V, 18DTT, 26DTT, 26TRT and 32TRT only.	LRC <sup>6</sup> Provides compatibility with Lithonia Reloc System.
	18DTT One 18W double twin-tube	6WTR Wheat	PCL Clear polycarbonate lens	ADEZ Advance Mark X electronic dimming ballast. (120V or 277V; 26DTT, 26TRT and 32TRT only.)	GMF Single slow-blow fuse.
	26DTT One 26W double twin-tube	6CR <sup>2</sup> Champagne Gold	T73 Tempered prismatic lens		RIF Radio interference filter.
	18TRT <sup>2</sup> One 18W tri-tube	6G <sup>3</sup> Gold	A12 Prismatic acrylic lens		ELR Emergency battery pack. Access above ceiling required. Remote test switch provided. (Consult factory for dimensional changes.)
	26TRT <sup>2</sup> One 26W tri-tube	6MB <sup>4</sup> Black Baffle Clear	PPC Prismatic polycarbonate lens		GSKT 1/8" x 3/8" foam gasketing.
32TRT <sup>2</sup> One 32W tri-tube	6WR <sup>3</sup> Clear			QDS <sup>7</sup> Quick-disconnect for easy ballast replacement.	
		6WB <sup>4</sup> Pewter			CSA Listed and labeled to comply with Canadian Standards.

### NOTES:

- 1 Available with magnetic ballast only.
- 2 Available with electronic ballast only.
- 3 Not recommended for use with compact fluorescent lamp; consult factory.
- 4 Not available with finishes.
- 5 Refer to options and accessories tab for additional ballast types.
- 6 For compatible Reloc systems, refer to options and accessories tab.
- 7 Not available with ELR option.

Finish	
(blank)	Specular low iridescent
LD	Semi-diffuse low iridescent

Voltage
120
277
347

### Accessories

- Order as separate catalog numbers.
- SC6 Sloped ceiling adaptor. Degree of slope must be specified (10D, 15D, 20D, 25D, 30D). Example: SC6 10D.
  - CTA6 Ceiling thickness adaptor. (Extends mounting frame to accommodate ceiling thickness up to 2").

# 6" AFV Open Reflector

Distribution curve    Distribution data    Output data    Coefficient of utilization    Illuminance Data at 30" Above Floor for a Single Luminaire

AFV 26DTT 6AR, (1) PL-C 26W/27/4P lamp, 1800 rated lumens, 0.7 s/mh, test no. 2196102901

Mount height	Initial fc at beam center	50% beam angle 37.5°		10% beam angle 78.2°	
		Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8'	39.0	3.7'	19.5	8.9'	3.9
10'	21.0	5.1'	10.5	12.2'	2.1
12'	13.1	6.5'	6.5	15.4'	1.3
14'	8.9	7.8'	4.5	18.7'	0.9
16'	6.5	9.2'	3.2	21.9'	0.6

AFV 26TRT 6AR, (1) PL-T 26W/30/4P lamp, 1800 rated lumens, 1.3 s/mh, test no. 2194021501

Mount height	Initial fc at beam center	50% beam angle 63.7°		10% beam angle 93.4°	
		Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8'	22.4	6.8'	11.2	11.7'	2.2
10'	12.0	9.3'	6.0	15.9'	1.2
12'	7.5	11.8'	3.7	20.2'	.7
14'	5.1	14.3'	2.6	24.4'	.5
16'	3.7	16.8'	1.9	28.7'	.4

AFV 32TRT 6AR, (1) PL-T 32W/30/4P lamp, 2400 rated lumens, 1.2 s/mh, test no. 2194021002

Mount height	Initial fc at beam center	50% beam angle 60.3°		10% beam angle 88.1°	
		Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8'	33.3	6.4'	16.7	10.6'	3.3
10'	17.9	8.7'	9.0	14.5'	1.8
12'	11.2	11.0'	5.6	18.4'	1.1
14'	7.6	13.3'	3.8	22.2'	.8
16'	5.5	15.7'	2.8	26.1'	.6

AFV 26TRT 6MB, (1) PL-T 26W/30/4P lamp, 1800 rated lumens, 1.1 s/mh, test no. 2196071003

Mount height	Initial fc at beam center	50% beam angle 55.6°		10% beam angle 85.5°	
		Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8'	23.6	5.8'	11.8	10.2'	2.4
10'	12.7	7.9'	6.3	13.9'	1.3
12'	7.9	10.0'	4.0	17.6'	0.8
14'	5.4	12.1'	2.7	21.3'	0.5
16'	3.9	14.2'	2.0	25.0'	0.4

AFV 32TRT 6MB, (1) PL-T 32W/30/4P lamp, 2400 rated lumens, 1.0 s/mh, test no. 2196071001

Mount height	Initial fc at beam center	50% beam angle 53.7°		10% beam angle 84.3°	
		Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8'	29.9	5.6'	14.9	10.0'	3.0
10'	16.1	7.6'	8.0	13.6'	1.6
12'	10.0	9.6'	5.0	17.2'	1.0
14'	6.8	11.6'	3.4	20.8'	0.7
16'	5.0	13.7'	2.5	24.4'	0.5

**NOTES:**

1. For electrical characteristics consult technical data tab.
2. Tested to current IES and NEMA standards under stabilized laboratory conditions. Various operating factors can cause differences between laboratory data and actual field measurements. Dimensions and specifications are based on the most current available data and are subject to change without notice.

DCF-370

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GOTHAM ARCHITECTURAL DOWNLIGHTING  
A DIVISION OF ACUITY LIGHTING GROUP, INC.  
1400 Lester Road Conyers Georgia 30012  
P 800 315 4982 F 770 860 3129  
www.gothamlighting.com



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**Product Number:** 20879  
**Order Abbreviation:** CF26DT/E/IN/827  
**General Description:** DULUX 26W triple compact fluorescent amalgam lamp with 4-pin base, integral EOL, 2700K color temperature, 82 CRI, for use with electronic and dimming ballasts

Product Information	
Abbrev. With Packaging Info.	CF26DTEIN827 50/CS 1/SKU
Average Rated Life (hr)	12000
Base	GX24Q-3
Bulb	T4
Color Rendering Index (CRI)	82
Color Temperature/CCT (K)	2700
Family Brand Name	Dulux® T/E
Industry Standards	IEC 60901- 3426
Initial Lumens at 25C	1800
Mean Lumens at 25C	1548
Maximum Overall Length - MOL (in)	5.0
Maximum Overall Length - MOL (mm)	126
NEMA Generic Designation (current)	CFTR26W/GX24Q/827
NEMA Generic Designation (old)	CFM26W/GX24Q/827
Nominal Wattage (W)	26.00

Additional Product Information
<a href="#">Product Documents, Graphs, and Images</a>
<a href="#">Compatible Ballast</a>
<a href="#">Packaging Information</a>



Footnotes
<ul style="list-style-type: none"> <li>• Approximate initial lumens after 100 hours operation.</li> <li>• The life ratings of fluorescent lamps are based on 3 hr. burning cycles under specified</li> </ul>

conditions and with ballast meeting ANSI specifications. If burning cycle is increased, there will be a corresponding increase in the average hours life.

- Rule of Thumb for Compact Fluorescent Lamps: Divide wattage of incandescent lamp by 4 to determine approximate wattage of compact fluorescent lamp that will provide similar light output.
- Amalgam compact fluorescent lamps provide at least 90% light output from 40-140 degrees F. Non-amalgam compact fluorescent lamps provide atleast 90% light output from 60-100 degrees F in the base up position, the temperature range is narrower for horizontal or base down.
- Minimum starting temperature is a function of the ballast; consult the ballast manufacturer.
- There is a NEMA supported, industry issue where T2, T4, and T5 fluorescent and compact fluorescent lamps operated on high frequency ballasts may experience an abnormal end-of-life phenomenon. This end-of-life phenomenon can result in one or both of the following: 1. Bulb wall cracking near the lamp base. 2. The lamp can overheat in the base area and possibly melt the base and socket. NEMA recommends that high frequency compact fluorescent ballasts have an end-of-life shutdown circuit which will safely and reliably shut down the system in the rare event of an abnormal end-of-life failure mode described above. The final requirements of this system are yet to be defined by ANSI. For additional information refer to NEMA papers on their WEBSITE at [www.NEMA.org](http://www.NEMA.org).
- SYLVANIA ECOLOGIC fluorescent lamps are designed to pass the Federal Toxic Characteristic Leaching Procedure (TCLP) criteria for classification as non-hazardous waste in most states. TCLP test results are available upon request. Lamp disposal regulations may vary, check your local & state regulations. For more information, please visit [www.lamprecycle.org](http://www.lamprecycle.org)
- This 4-pin DULUX lamp has an internal end-of-life mechanism (EOL) that shuts down the lamp preventing abnormal end-of life failure modes. This lamp was designed for use with high frequency ballasts that do not have their own end-of-life (lamp)sensing circuits, but it is also compatible with high frequency ballasts that have their own end-of-life (lamp) sensing circuits.

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**Product Number:** 51738

**Order Abbreviation:** QTP 1/2XCF UNV B M

**General Description:** 1/2-lamp universal 120-277V programmed rapid start normal ballast factor electronic ballast in a metal enclosure bottom mount without leads for 26W 4-pin compact fluorescent lamp

#### Product Information

Abbrev. With Packaging Info.	QTP12XCFUNVBM
Ballast Factor	1.00
Ballast Height H (in)	1.3500
Ballast Length L (in)	4.9500
Ballast Width W (in)	2.9300
Circuit Type	Series
Family Brand Name	QUICKTRONIC Professional
Input Wattage (W)	32.00
Nominal Voltage (V)	UNIVERSAL 120-277
Number of Lamps	1
Power Factor	>98%
Sound Rating	A
Starting Method	Programmed Rapid Start
Starting Temperature - Fahrenheit	-5
Starting Temperature - Celsius	-20
Total Harmonic Distortion (THD)	<10%
Wiring Method	Plug-in Connectors

#### Additional Product Information

[Product Documents, Graphs, and Images](#)

[Compatible Lamps](#)

[Packaging Information](#)



#### Footnotes

- 70C Max Case Temperature
- UL Listed Class P, Type 1 Outdoor
- Ground ballast case
- Install in accordance with National Electric Codes

- Complies with FCC 47 CFR Part 18, Non-Consumer
- Input Frequency: 50/60Hz.
- Remote Mounting up to 19 feet (keep red wires short for 1&2 lamp).
- Remote Mounting up to 19 feet (keep red wires short for 1&2 lamp models).
- ANSI C62.41 cat. B3 Transient Protection.
- Remote mounting - Typically 6ft with suitable ground plane, but varies by model and application. Contact ECS Application Engineering for information on longer applications.

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