

ALLIANT ENERGY CENTER

ENERGY LOSS THRU DOOR OPENING

GIVEN CONDITIONS

FROM 2001 ASHRAE HANDBOOK OF FUNDAMENTALS, PAGE. 26.11,
Eqn. 30, ENERGY FLOW DUE TO THERMAL FORCES:

$$Q = 60 \cdot C_D \cdot A \cdot \sqrt{2 \cdot g \cdot H_{NPL} \cdot (T_i - T_o) / T_i}$$

WHERE $C_D = \text{ABS}(T_i - T_o) * 0.0025 + 0.4$
(IN Eqn. 30, IF $T_o > T_i$, SUBSTITUTE $(T_o - T_i)/T_o$)

CALCULATIONS ASSUME THAT THE DOOR IS OPENED MAINLY BETWEEN 8 AM AND 4 PM, 2 Day/Wk, FOR APPROXIMATELY 696 HOURS PER YEAR. THE CALCULATIONS ALSO ASSUME NO SAVINGS BETWEEN 50 °F AND 60 °F DUE TO ECONOMIZER OPERATION. THE CALCULATION PROCESS FIRST DETERMINES FROM BIN DATA THE NUMBER OF HOURS IN EACH 5 DEGREE BIN. THEN HEATING AND COOLING ENERGY IS CALCULATED.

g =	32.2 ft/sec ²
A =	240 ft ²
H _{NPL} =	10 ft
T _(WINTER) =	68 °F
T _(SUMMER) =	75 °F
ENTHALPY @ 75 °F & 50% RH =	28.1 BTU/lb _M

HOURS ADJUSTMENT

BIN TEMP., °F			ADJUSTED HOURS, 2 Days/Wk 8am - 4pm	ADJUSTED TO 696 HOURS
97.5				
92.5			9	8
87.5			30	25
82.5			56	47
77.5			73	61
72.5			73	61
67.5			64	53
62.5			56	47
57.5			46	*
52.5			41	*
47.5			44	37
42.5			46	38
37.5			60	50
32.5			69	58
27.5			57	48
22.5			38	32
17.5			25	21
12.5			19	16
7.5			13	11
2.5			8	7
-2.5			4	3
-7.5			2	2
-12.5			0	0
-17.5			0	0
-22.5			0	0

* HOURS NOT INCLUDED DUE TO ECONOMIZER OPERATION

GENERAL CALCULATIONS

C _D	Q, CFM
0.44	78,331
0.43	64,337
0.42	48,391
0.41	27,104
0.41	27,104
0.42	48,391
0.43	64,337
ECONOMIZER OPERATION	
0.45	90,541
0.46	103,778
0.48	116,556
0.49	129,048
0.50	141,362
0.51	153,571
0.52	165,725
0.54	177,863
0.55	190,010
0.56	202,189
0.58	214,416
0.59	226,702
0.60	239,058
0.61	251,493
0.63	264,012

HEATING CALCULATION

	MBH	MBH/YR
4		
3		
2		
1		
1		
2		
3		
	ECONOMIZER OPERATION	
4	2,005	73,695
5	2,858	109,848
6	3,839	192,475
6	4,948	285,245
7	6,183	294,477
7	7,546	239,603
8	9,039	188,803
8	10,661	169,246
9	12,415	134,854
10	14,303	95,604
10	16,326	54,562
11	18,485	30,890
11	20,784	0
12	23,223	0
12	25,804	0

1,869,302
@ 80% EFFICIENCY =
23,366 THERMS

\$0.50 Therm Rate

\$11,683.14

AIR CONDITIONING CALCULATION

[illegible]

303,911
@ 12,000 BTUs/TON & 0.8 kW/TON =
20,261 kWh

\$0.14 kWh Rate
\$2,836.50

BIN HRS Madison, WI 2 Days/Wk 8am 4 pm		
Deg	BIN	HR
97	6	
92	9	
87	30	
82	56	
77	73	
72	73	
67	64	
62	56	
57	46	
52	41	
47	44	
42	46	
37	60	
32	69	
27	57	
22	38	
17	25	
12	19	
7	13	
2	8	
-3	4	
-8	2	
-13	0	
-18	0	
-23	0	
-28	0	
		839

\$14,519.64 Combined Annual Savings

\$212,825.00 Project Cost

14.66 Payback Period