Date: March 14, 2017
To: Sargon Ishaya, HVAC Project Manager
From: Team SS, team of mechanical engineering students
Subject: Progress Meeting (25%) regarding the HVAC project in ME 183

Memorandum

Please see the enclosed documents outlining our progress on HVAC Design Project 1. Attached are the zoning plan, basis of design, floor plan scaling, airflow quantities, and system checksums report. If any design changes are necessary, please let us know by 3/23/17.

M E C H A N I C A L H V A C
B A S I S O F D E S I G N

PROJECT: Mechanical Design of Office Floor

PREPARED BY: **Team SS**
Thien Hua
Matthew Stewart
Steven Saelee

Date: March 23, 2017

REV	DESCRIPTION	DATE
0	Added Space and Load Criteria, Zoning Plan	3/14/17
1	Added Ventilation Criteria	3/16/17
2	Added Appendix A	3/20/17

MECHANICAL / HVAC

1.0 Design Criteria

1.1 Outdoor Design Criteria

Season	Criteria	Basis
Summer	85.2°F dry bulb 65.2°F coincident wet bulb	2009 ASHRAE, 2% Criteria San Jose, CA
Winter	35.7°F db	2009 ASHRAE, 99.6% Criteria San Jose, CA

1.2 Space Criteria

The following areas will be conditioned as follows. Cubicles will be combined according to the zoning plan. Noise control based on Price Corporation 24” x 24” square plaque diffusers.

Setpoint Temperature	Cooling Dry Bulb	Heating Dry Bulb	Noise
72F	70F	72F	NC < 30

Offices	Floor Area (ft²)
Offices 2017,18,21,22	518
Offices 2025,26,29,30	509
Offices 2033,34,37,38	483
Offices 2019,20,23,24	516
Offices 2027,28,31,32	507
Offices 2035,36,39,40	482
Offices 2009,10,11,12,13,14,15,16,H2009A	1,067
Offices 2005,6,7,8,H2005A	781
Open Office 2041	1,275
Offices 2042,43,44	255
Office 2046	84
Office 2047	84
Office 2048	84
Office 2004	182
Office 2002	114
Office 2003	114
Office 2085	188
Offices 2088 - 2089	173
Offices 2058,59,60,61,H2057A,H2060A	569
Office 2065	129

Offices	Floor Area (ft^2)
Offices 2062 - 2063	189
Office 2064	123
Offices 2093,94,95,96	398
Offices 2067 - 2076	1,455
Offices 2119 - 2125	540
Offices 2111 - 2118	722
Offices 2103 - 2110	722
Office 2084	185
Office 2082	116
Office 2083	127
Office 2080	116
Office 2081	134
Office 2079	285
Break 2055/Open Office 2090	3,326
Hong Kong Pit Open Office 2077	962

Conference Rooms	
Conference 2001	242
Conference 2086	228
Conference 2056	228
Conference 2102	279

Labs	
Protoman Lab 2097	422
Fandango Lab 2098	817
Lab Network 2099	161
Shunra Lab 2100	228
Chotchckies Lab 2057	599

Miscellaneous	
Lobby 2000	481
Janitor 2000B	1,047
Copy/Mail 2050	224
MOTHER RM 2051	69
STOR 2052	77
Lounge/Game 2053	262
Coffee 2054	249
STOR 2049	108
STOR 2087	162
STOR 2101	189
Hallway 2065A	211
Print 2066	421
TELE IDF	97
Print 2078	825

1.3 Load Criteria

	People	Lights	Equipment
Office	150 sq. ft/person	1.2 W/sq. ft	0.5 W/sq. ft
Conference	# of chairs in room	1.2 W/sq. ft	0.5 W/sq. ft
Lab	# of stations	1.2 W/sq. ft	0.5 W/sq. ft
Misc	150 sq. ft/person	1.2 W/sq. ft	0.5 W/sq. ft

1.4 Minimum Ventilation Criteria

The ventilation of each area shall be per Title-24 meaning the greater of:

a. 0.15 cfm per square foot
b. 50 cfm per person

1.5 Envelope Assumptions

Component	U-value	SC	Basis	Height
Wall	0.091	-	R-11 insulation	15-feet floor to roof
Roof	-	-	Ignore Roof	-
Windows	0.95	0.7	Single Clear ¼”	72” tall, width per architectural
Skylights	n/a	n/a	No skylights in scope	n/a

Notes: (n/a= not applicable, n/c = no control)

1.6 Zoning Criteria

Please see the zoning plan attached to this document. Cubicles have been grouped into zones under 3000 ft^2.

Appendix A: Airflow Calculations

Airflow is calculated from the following formula:

$$cfm = \frac{Q_{sens}}{1.1 * \Delta T}$$

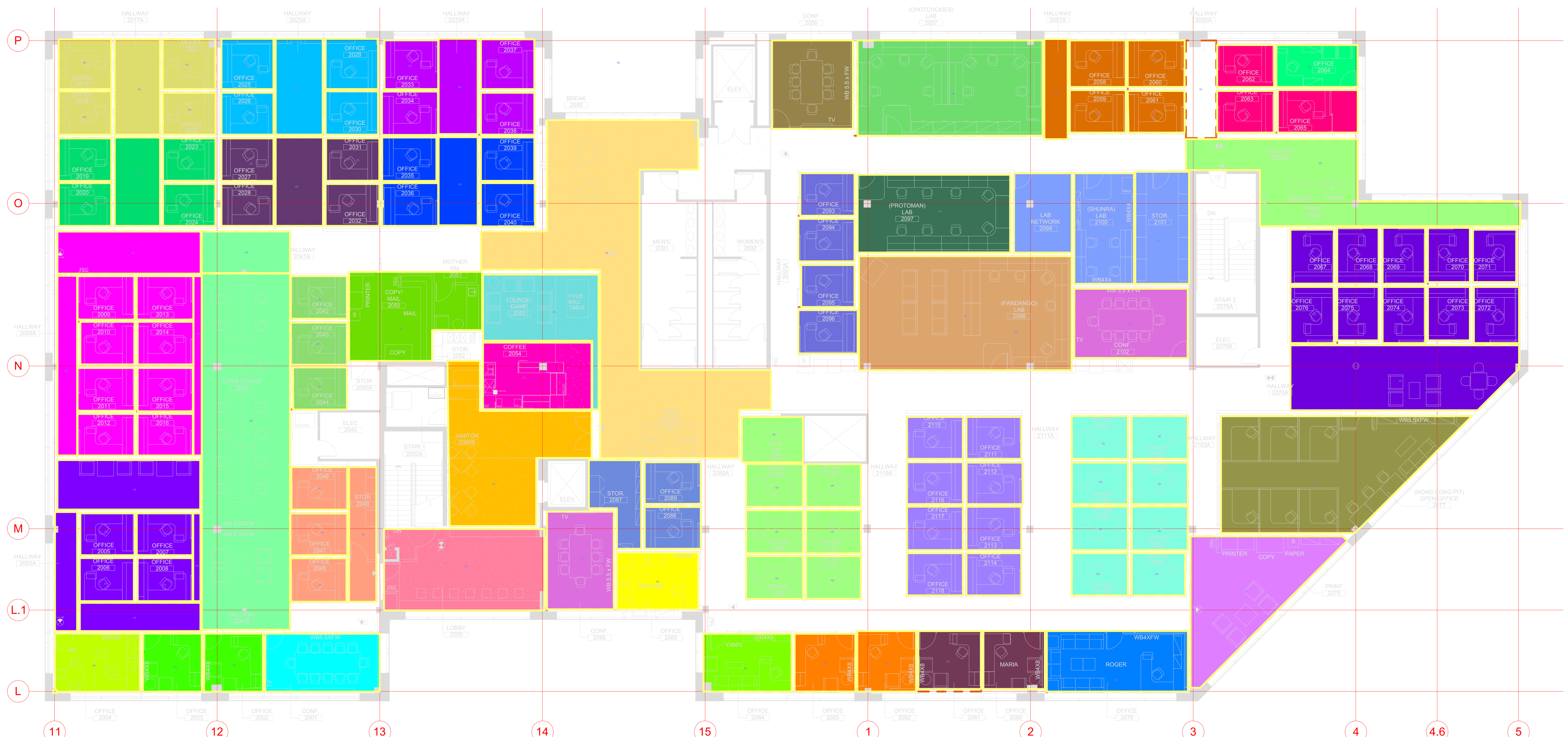
where Q_{sens} is the sensible cooling load of the area and ΔT is the difference between supply and set point temperature (72F set point, 55F supply).

Offices	Airflow (cfm)
Offices 2017,18,21,22	1445.2
Offices 2025,26,29,30	992.1
Offices 2033,34,37,38	1250.1
Offices 2019,20,23,24	549.3
Offices 2027,28,31,32	192.3
Offices 2035,36,39,40	182.6
Offices 2009,10,11,12,13,14,15,16,H2009A	1543.2
Offices 2005,6,7,8,H2005A	1129.3
Open Office 2041	483.2
Offices 2042,43,44	96.8
Office 2046	31.8
Office 2047	31.8
Office 2048	31.8
Office 2004	693.2
Office 2002	224.8
Office 2003	315.2
Office 2085	464.8
Offices 2088 - 2089	65.7
Offices 2058,59,60,61,H2057A,H2060A	1070.8
Office 2065	277.4
Offices 2062 - 2063	356.4
Office 2064	512.3
Offices 2093,94,95,96	150.7
Offices 2067 - 2076	1420.5
Offices 2119 - 2125	204.5
Offices 2111 - 2118	273.8
Offices 2103 - 2110	273.8
Office 2084	584.3
Office 2082	196.0
Office 2083	350.9
Office 2080	196.3
Office 2081	365.6
Office 2079	746.1
Break 2055/Open Office 2090	1260.8
Hong Kong Pit Open Office 2077	926.4

Conference Rooms	Airflow (cfm)
Conference 2001	1017.9
Conference 2086	506.8
Conference 2056	557.7
Conference 2102	281.5

Labs	Airflow (cfm)
Protoman Lab 2097	256.0
Fandango Lab 2098	437.4
Lab Network 2099	60.9
Shunra Lab 2100	173.1
Chotchckies Lab 2057	1204.4

Miscellaneous	Airflow (cfm)
Lobby 2000	947.2
Janitor 2000B	396.7
Copy/Mail 2050	85.0
MOTHER RM 2051	26.1
STOR 2052	29.3
Lounge/Game 2053	99.4
Coffee 2054	94.3
STOR 2049	41.0
STOR 2087	61.3
STOR 2101	71.7
Hallway 2065A	305.0
Print 2066	957.6
TELE IDF	36.8
Print 2078	802.1



SECOND FLOOR

THE SS COMPANY

LEGENDS

*NOTE:COLOR SCHEME BY ZONES

DATE	NO.	REVISION
03/14/17	1	Progress Meeting 1
03/17/17	2	DESIGN REVISIONS
03/23/17	3	AS BUILT

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NORTH DIRECTION

PROJECT 1 .DWG

FLOOR DRAWING NO. 1

SCALE: 0.000564"

DATE: 3/23/17

ACT. NO. 1

THE SS COMPANY

LEGENDS

SUPPLY DIFFUSER

RETURN DIFFUSER

DATE	NO.	REVISION
03/14/17	1	Progress Meeting 1
03/17/17	2	DESIGN REVISIONS
03/23/17	3	AS BUILT

SECOND FLOOR

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NORTH DIRECTION

PROJECT 1 .DWG

FLOOR DRAWING NO. 1

SCALE: 0.00634"

DATE: 3/23/17

ACT. NO. 1

System Checksums

By Therma

System - 001 **Single Zone**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 14
Outside Air: OADB/WB/HR: 80 / 68 / 83

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	14,453	14,453	2
Glass Solar	266,332	0	266,332	31
Glass Cond	66,638	0	66,638	8
Wall Cond	219	3,413	3,632	0
Partition	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	333,189	17,866	351,055	41
Internal Loads				
Lights	82,369	20,592	102,961	12
People	122,658	0	122,658	14
Misc	42,901	0	42,901	5
Sub Total ==>	247,927	20,592	268,519	31
Ceiling Load	6,670	-6,670	0	0
Ventilation Load	0	0	97,336	11
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-12,451	-12,451	-1
Sup. Fan Heat			80,390	9
Ret. Fan Heat		80,390	80,390	9
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	587,786	99,728	865,241	100.00

CLG SPACE PEAK

Mo/Hr: Sum of
OADB: Peaks

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	263,231	50
Glass Cond	71,882	14
Wall Cond	219	0
Partition	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	335,333	63
Internal Loads		
Lights	82,369	16
People	61,329	12
Misc	42,901	8
Sub Total ==>	186,598	35
Ceiling Load	9,106	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	531,038	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 36

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-41,235	8.60
Glass Solar	0	0	0.00
Glass Cond	-298,110	-298,110	62.16
Wall Cond	-423	-7,269	1.52
Partition	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-298,533	-346,614	72.27
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-8,382	0	0.00
Ventilation Load	0	-134,240	27.99
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-3,144	-3,144	0.66
Exhaust Heat		4,414	-0.92
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-310,059	-479,584	100.00

TEMPERATURES

	Cooling	Heating
SADB	57.9	76.2
Ra Plenum	72.8	67.0
Return	75.0	67.0
Ret/OA	75.6	63.5
Fn MtrTD	0.2	0.0
Fn BldTD	0.5	0.0
Fn Frict	1.4	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	33,914	33,914
Terminal	33,914	33,914
Main Fan	33,914	33,914
Sec Fan	0	0
Nom Vent	3,771	3,771
AHU Vent	3,771	3,771
Infil	0	0
MinStop/Rh	0	0
Return	33,914	33,914
Exhaust	3,771	3,771
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	11.1	11.1
cfm/ft²	1.35	1.35
cfm/ton	470.35	
ft²/ton	348.66	
Btu/hr·ft²	34.42	-19.08
No. People	245	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	72.1	865.2	741.8	33,914	75.6	62.0	61.4	55.8	53.2	56.4
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
Total	72.1	865.2								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	25,139		
Part	0		
ExFlr	0		
Roof	25,139	0	0
Wall	12,730	10,153	80

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-479.6	33,914	63.5	76.2
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	0.0	0	0.0	0.0
Total	-479.6			

System Checksums

By Therma

System - 001 **Single Zone**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 14
Outside Air: OADB/WB/HR: 80 / 68 / 83

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	14,455	14,455	2
Glass Solar	266,332	0	266,332	32
Glass Cond	66,638	0	66,638	8
Wall Cond	219	3,413	3,633	0
Partition	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	333,189	17,868	351,057	42
Internal Loads				
Lights	82,369	20,592	102,961	12
People	91,658	0	91,658	11
Misc	42,901	0	42,901	5
Sub Total ==>	216,927	20,592	237,519	28
Ceiling Load	6,658	-6,658	0	0
Ventilation Load	0	0	97,809	12
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-12,445	-12,445	-1
Sup. Fan Heat			80,572	10
Ret. Fan Heat		80,572	80,572	10
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	556,774	99,930	835,084	100.00

CLG SPACE PEAK

Mo/Hr: Sum of
OADB: Peaks

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	263,231	51
Glass Cond	71,882	14
Wall Cond	219	0
Partition	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	335,333	65
Internal Loads		
Lights	82,369	16
People	45,829	9
Misc	42,901	8
Sub Total ==>	171,098	33
Ceiling Load	9,090	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	515,522	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 36

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-41,237	8.60
Glass Solar	0	0	0.00
Glass Cond	-298,110	-298,110	62.16
Wall Cond	-423	-7,270	1.52
Partition	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-298,533	-346,617	72.28
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-8,367	0	0.00
Ventilation Load	0	-134,240	27.99
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-3,097	-3,097	0.65
Exhaust Heat		4,406	-0.92
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-309,997	-479,547	100.00

TEMPERATURES

	Cooling	Heating
SADB	58.4	76.2
Ra Plenum	72.8	67.0
Return	75.0	67.0
Ret/OA	75.6	63.5
Fn MtrTD	0.2	0.0
Fn BldTD	0.5	0.0
Fn Frict	1.4	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	33,990	33,990
Terminal	33,990	33,990
Main Fan	33,990	33,990
Sec Fan	0	0
Nom Vent	3,771	3,771
AHU Vent	3,771	3,771
Infil	0	0
MinStop/Rh	0	0
Return	33,990	33,990
Exhaust	3,771	3,771
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	11.1	11.1
cfm/ft²	1.35	1.35
cfm/ton	488.43	
ft²/ton	361.25	
Btu/hr·ft²	33.22	-19.08
No. People	183	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	69.6	835.1	726.7	33,990	75.6	61.9	61.3	56.2	53.5	56.9
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
Total	69.6	835.1								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	25,139		
Part	0		
ExFlr	0		
Roof	25,139	0	0
Wall	12,730	10,153	80

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-479.6	33,990	63.5	76.2
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	0.0	0	0.0	0.0
Total	-479.6			