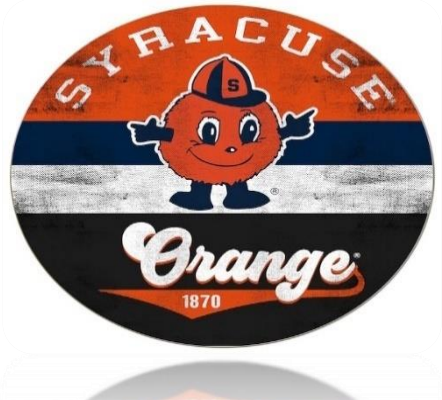
MAE. 553 HVAC ANALYSIS AND DESIGN

TWO-STOREY APARTMENT SIZING REPORT – BY CARRIER HAP (HOURLY ANALYSIS PROGRAM)

FINAL PROJECT REPORT - 12/16/2023



DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING
SYRACUSE UNIVERSITY

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OBJECTIVE:

- **Conducting a comprehensive evaluation of the house design, considering factors such as heat loss, and heat gain, and extracting sizing reports through Carrier HAP (Hourly Analysis Program).**

- **Ensure optimal home comfort through a detailed assessment, providing actionable recommendations for improvement.**

- **Gaining a strong understanding of Carrier HAP (Hourly Analysis Program) software functionalities.**

- **Leverage Carrier HAP (Hourly Analysis Program) to evaluate HVAC system efficiency, insulation effectiveness, and the impact on windows and ventilation.**

- **Presenting detailed sizing reports to the landlord, offering comprehensive recommendations.**

BUILDING DESCRIPTION

- **Building Name:** SU Good Living, 2 Storey Apartment
- **Year:** 1923 (As per Landlord)
- **Size:** 2376 sq. ft
- **Ceiling Height:** 9ft
- **Cost:** $200,000 (As per Landlord)
- **Number of Floors:** Two
- **LEED Certification:** No
- **Location:** 312 Green Wood Place, Syracuse, New York - 13210
- **Purpose/Accessibility:** Apartment for Students

Short Description: SU Good Living, 2 Storey Apartment, a charming two-story structure built in 1923, offers a total size of 2376 sq. Ft with a ceiling height of 9ft. Located at 312 Green Wood Place, Syracuse, New York, it serves as an apartment for students. While not LEED certified, the historical residence exudes character and is a unique living space. The cost of construction amounted to $200,000, creating a distinctive home in a well-accessible location."

- **Windows:**
  - There are 7 windows on the first floor and 7 on the second floor.
  - 2 pane windows
  - Storm windows are not present.
- **Walls:**
  - The walls are made of wood.
  - Uninsulated wood frame
- **Roof:**
  - Asphalt Single
- **Lighting:** LED lighting system for each floor
- **Lighting Control:** Switch
- **Heating Plant & Distribution System:**
  - Gas Furnace – Forced Air with Ductwork
  - Electric Baseboard Heat – Few Rooms
- **Cooling Plant & Distribution System:**
  No Cooling System is Provided.
- **Control System:** Honeywell – Thermostat

- **Deficiencies that I identify and recommend Landlord for improving?**
  Considering the two-story apartment with a heating system but no cooling, I recommend installing an air conditioning unit. Additionally, consider a zoning system for independent temperature control on different floors. If year-round climate control is a priority, incorporate air conditioning, as the house is already equipped with a heating system, allows for year-round comfort control without necessitating a heat pump; however, opting for a heat pump would notably contribute to lowering carbon emissions—an imperative step towards eliminating reliance on fossil fuels. Regular HVAC maintenance is crucial for optimal heating system performance. Smart thermostats offer convenience and energy savings while ensuring proper insulation and ventilation are essential for consistent indoor comfort. Consulting with an HVAC professional will help tailor the best solution for the specific needs.

EXTERIOR AND INTERIOR PICTURES OF BUILDING

Fig A: Heating Unit

Fig B: House Exterior

Fig C: Vent Pipe

Fig C1: Distribution System – Duct Work

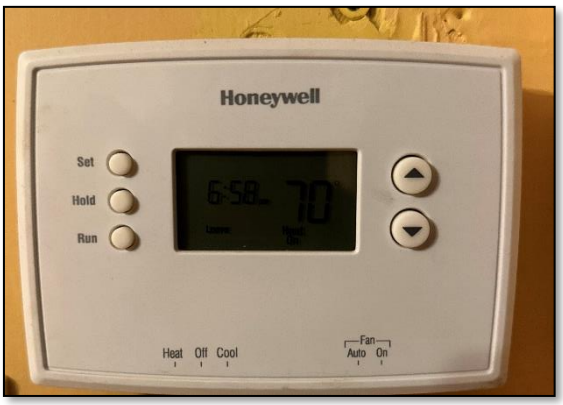

Fig D: Honey Well -Thermostat

Fig E: Grill Ducted System

Fig F: Grill Ducted System

Fig G: Electric Baseboard Heater

INPUT REPORTS: CEILING

BW Std Ceiling

Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Light**
Outside Absorptivity **0.450**
Overall U-Value ..... **0.083** BTU/(hr sqft F)

Ceiling Assembly Layers - (Outside Space to Inside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Outside Surface Resistance				0.46000	
R-11 batt insulation	3.520	0.5	0.20	11.00000	0.1
Inside Surface Resistance				0.61000	
Totals	**3.520**	**-**	**-**	**12.07000**	**0.1**

FLOOR

BW Std Floor

Floor Type ..... **Floor Above Space**
Inside Surface Color ..... **Medium**
Inside Absorptivity **0.675**
Outside Surface Color ..... **Medium**
Outside Absorptivity **0.675**
Overall U-Value ..... **0.312** BTU/(hr sqft F)

Floor Assembly Layers - (Inside Space to Outside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Inside Surface Resistance				0.92000	
Carpet with rubber pad, R-1.23	0.500	18.0	0.33	1.23000	0.8
8 in. HW concrete	8.000	140.0	0.22	0.59259	93.3
22-gauge steel roof deck	0.034	489.0	0.12	0.00009	1.4
Outside Surface Resistance				0.46000	
Totals	**8.534**	**-**	**-**	**3.20268**	**95.5**

Slab-on-grade floor

Floor Type ..... **Slab Floor On Grade**
Inside Surface Color ..... **Medium**
Inside Absorptivity **0.675**
Overall U-Value ..... **0.733** BTU/(hr sqft F)

Floor Assembly Layers - (Inside Space to Soil)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Inside Surface Resistance				0.92000	
6 in. HW concrete	6.000	140.0	0.22	0.44444	70.0
Totals	**6.000**	**-**	**-**	**1.36444**	**70.0**

ROOF

Roof Constructions

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Default Roof

Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Light**
Outside Absorptivity **0.450**
Overall U-Value ..... **0.037** BTU/(hr sqft F)

Roof Assembly Layers - (Outside to Inside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Outside Surface Resistance				0.17000	
1/2-in plywood	0.500	34.0	0.45	0.67564	1.4
R-25 board insulation	5.000	2.5	0.35	25.00000	1.0
1/2-in gypsum board	0.500	50.0	0.26	0.44803	2.1
Inside Surface Resistance				0.61000	
Totals	**6.000**	**-**	**-**	**26.90367**	**4.5**

WALL

Default Wall

Wall Type ..... **Exterior, Above Grade Wall**
Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Medium**
Outside Absorptivity **0.675**
Overall U-Value ..... **0.074** BTU/(hr sqft F)

Wall Assembly Layers - (Inside Space to Outside)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Inside Surface Resistance				0.68000	
1/2-in gypsum board	0.500	50.0	0.26	0.44803	2.1
3.5-in cavity, 16-in o.c. steel frame, R-13 batt	3.500	3.4	0.20	6.00000	1.0
R-5 board insulation	1.000	2.5	0.35	5.00000	0.2
1/2-in wood	0.500	38.0	0.39	0.47170	1.6
1/2-in plywood	0.500	34.0	0.45	0.67564	1.4
Outside Surface Resistance				0.17000	
Totals	**6.000**	**-**	**-**	**13.44537**	**6.3**

Interior Gypsum Board Wall

Wall Type ..... **Interior Wall**
Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Light**
Outside Absorptivity **0.450**
Overall U-Value ..... **0.303** BTU/(hr sqft F)

Wall Assembly Layers - (Inside Space to Outside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Inside Surface Resistance				0.68000	
1/2-in plywood	0.500	34.0	0.45	0.67564	1.4
3.5-in cavity, 16-in o.c. steel frame, no insul	3.500	2.9	0.01	0.79000	0.8
1/2-in wood	0.500	38.0	0.39	0.47170	1.6
Outside Surface Resistance				0.68000	
Totals	**4.500**	**-**	**-**	**3.29734**	**3.8**

WINDOW

Default Window

Input Method ..... **Detailed input method**

Window Performance:

Height ..... **3.50** ft
Width ..... **2.70** ft
Frame Type ..... **Vinyl**

Number of Glazings **2**

Glazing	Glazing Name	Thickness (in)	Conductivity (BTU/(hr ft F))	Low-E	Transmissivity	Reflectivity	Absorptivity
Outer Glazing #1	Clear	0.125	0.520	-	0.841	0.078	0.081
Glazing #2	Clear	0.125	0.520	No	0.841	0.078	0.081

Gap Type ..... **1/4" Air Space**

Overall U-Value ..... **0.579** BTU/(hr sqft F)
Overall SHGC **0.682**
Overall VT **0.633**

Internal Shade:

Type ..... **None**

DOOR

2019 Zone 5 Glass, entrance door

Door Type	**Glass Door**	
Glass U-Value	**0.630**	BTU/(hr sqft F)
Glass SHGC	**0.330**	
Glass VT	**0.363**	

SPACE MODEL

BLD1 - Space Model

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1. General Information

Space Model ..... BLD1 - Space Model
Building ..... BLD1 - Building
Notes:

2. Spaces

The space model contains 3 spaces with total floor area of 2,376 sqft.

2.1. Ventilation

Index	Space	Level	Floor Area (sqft)	Space Type	Ventilation						
					ASHRAE Standard 62.1-2019 Space Usage	OA Requirement 1		OA Requirement 2		Direct Exhaust	
						Airflow	Units	Airflow	Units	Airflow	Units
1	L1-Z01	Level 1	791.9	(None)	HOTEL / MOTEL / RESORT / DORM: Bedroom/living room	5.0	CFM/person	0.06	CFM/sqft	0.0	CFM
2	L2-Z01	Level 2	791.9	(None)	HOTEL / MOTEL / RESORT / DORM: Bedroom/living room	5.0	CFM/person	0.06	CFM/sqft	0.0	CFM
3	L3-Z01	Level 3	791.9	(None)	HOTEL / MOTEL / RESORT / DORM: Bedroom/living room	5.0	CFM/person	0.06	CFM/sqft	0.0	CFM

2.2. Overhead Lighting and Daylighting Control

Index	Space	Overhead Lighting							Daylighting Control		
		ASHRAE Standard 90.1-2019		Power	Units	Lighting Type	Schedule	Power Multi.	Control Type	Illum. Setpoint	Units
		Lighting Method	Space Usage								
1	L1-Z01	Building Area	User Defined	0.45	W/sqft	LED: Free Hanging	90.1 Hotel/Motel Lights/Elec	1.00	Not Used	---	---
2	L2-Z01	Building Area	User Defined	0.45	W/sqft	LED: Free Hanging	90.1 Hotel/Motel Lights/Elec	1.00	Not Used	---	---
3	L3-Z01	Building Area	User Defined	0.45	W/sqft	LED: Free Hanging	90.1 Hotel/Motel Lights/Elec	1.00	Not Used	---	---

2.3. Task Lighting, Electric Equipment and Miscellaneous Heat Gain

Index	Space	Task Lighting			Electric Equipment			Miscellaneous Heat Gain			
		Power	Units	Schedule	Power	Units	Schedule	Sens. (BTU/hr)	Schedule	Latent (BTU/hr)	Schedule
1	L1-Z01	0.00	W/sqft	(None)	0.25	W/sqft	90.1 Hotel/Motel Lights/Elec	0	(None)	0	(None)
2	L2-Z01	0.00	W/sqft	(None)	0.25	W/sqft	90.1 Hotel/Motel Lights/Elec	0	(None)	0	(None)
3	L3-Z01	0.00	W/sqft	(None)	0.25	W/sqft	90.1 Hotel/Motel Lights/Elec	0	(None)	0	(None)

2.4. Occupancy and Infiltration

Index	Space	Occupants						Infiltration				
		Occupancy	Units	Schedule	Activity Level	Sens. (BTU/hr/person)	Latent (BTU/hr/person)	Cooling Airflow	Heating Airflow	Simulation Airflow	Units	Occurs
1	L1-Z01	100.0	sqft/person	90.1 Hotel/Motel Occupancy	Medium Work	295.0	455.0	0.00	0.00	0.00	ACH	Unoccupied
2	L2-Z01	100.0	sqft/person	90.1 Hotel/Motel Occupancy	Medium Work	295.0	455.0	0.00	0.00	0.00	ACH	Unoccupied
3	L3-Z01	100.0	sqft/person	90.1 Hotel/Motel Occupancy	Medium Work	295.0	455.0	0.00	0.00	0.00	ACH	Unoccupied

3. Zoning

Zone	Space	Level
L1-Z01		
	L1-Z01	Level 1
L2-Z01		
	L2-Z01	Level 2
L3-Z01		
	L3-Z01	Level 3
Unconditioned (no spaces)		
Unassigned (no spaces)		

4. Assemblies

Category	Surface Group	Selected Assembly
Exterior Above Grade Wall		
	Default	Default Wall
Roof		
	Default	Default Roof
Ceiling		
	Interior Ceilings	BW Std Ceiling
Floor Above Space		
	Interior Floors Above Space	BW Std Floor
Slab Floor On Grade		
	At-Grade Floors	Slab-on-grade floor

5. Windows & Doors

Category	Tag	Width x Height, Elevation	Selected Assembly
Window			
	W001	21' 7 31/32" x 2' 4 13/16" , 3' 3 19/32"	Default Window
	W002	35' 7 31/32" x 2' 4 13/16" , 3' 3 19/32"	Default Window

OUTPUT REPORTS: DESIGN LOADS

Air System Sizing Summary for ALT1 - L1-Z01 (on Level 1)
(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023
Prepared by: HVAC Project_Syracuse University 20:43

Air System Information

Air System Name	**ALT1 - L1-Z01 (on Level 1)**	Number of zones	**1**	
Equipment Class	**UNDEF**	Floor Area	**791.9**	sqft
Air System Type	**SZCAV**	Location	**Syracuse Hancock Intl, NY, USA**	

Sizing Calculation Information

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

Central Cooling Coil Sizing Data

Total coil load	**0.1**	Tons	Peak coil load occurs at	**September 15:00**	
Total coil load	**1.0**	MBH	OA DB / WB	**83.2 / 70.0**	F
Sensible coil load	**0.5**	MBH	Entering DB / WB	**60.0 / 56.1**	F
Coil CFM at peak load	**1123**	CFM	Leaving DB / WB	**59.6 / 55.8**	F
Sum of peak zone CFM	**1123**	CFM	Resulting RH	**50**	%
Sensible heat ratio	**0.554**		Design supply temp.	**58.0**	F
CFM/Ton	**13911.0**		Zone T-stat Check	**1 of 1**	OK
sqft/Ton	**9809.1**		Max zone temperature deviation	**0.0**	F
BTU/(hr sqft)	**1.2**				
Water flow @ 10.0 F rise	**0.19**	gpm			

Central Heating Coil Sizing Data

Max coil load	**30.1**	MBH	Load occurs at	**Design Heating**	
Coil CFM at Design Heating	**1123**	CFM	BTU/(hr sqft)	**38.0**	
Max coil CFM	**1123**	CFM	Ent. DB / Lvg DB	**60.0 / 84.9**	F
Water flow @ 20.0 F drop	**3.01**	gpm			

Precool Coil Sizing Data

Total coil load	**2.0**	Tons	Load occurs at	**August 17:00**	
Total coil load	**24.1**	MBH	OA DB / WB	**88.1 / 72.7**	F
Sensible coil load	**18.8**	MBH	Entering DB / WB	**75.5 / 63.7**	F
Coil CFM at August 17:00	**1123**	CFM	Leaving DB / WB	**60.0 / 56.5**	F
Max coil CFM	**1123**	CFM			
Sensible heat ratio	**0.780**				
Water flow @ 10.0 F rise	**4.83**	gpm			

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Humidifier Sizing Data

Max steam flow at Design Heating	**1.69**	lb/hr	Air mass flow	**4978.58**	lb/hr
Airflow Rate	**1123**	CFM	Moisture gain	**.00034**	lb/lb

Dehumidification Reheat Coil Sizing Data

No dehumidification reheat coil loads occurred during this calculation.

Supply Fan Sizing Data

Design CFM	**1123**	CFM	Fan motor BHP	**0.62**	BHP
Design CFM/sqft	**1.42**	CFM/sqft	Fan motor kW	**0.49**	kW
			Fan total static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM	**1123**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**1106**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/sqft	**1.42**	CFM/sqft	Fan total static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**87**	CFM	CFM/person	**11.00**	CFM/person
CFM/sqft	**0.11**	CFM/sqft			

Zone Sizing Summary for ALT1 - L1-Z01 (on Level 1)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023
Prepared by: HVAC Project_Syracuse University 20:43

Air System Information

Air System Name ..... **ALT1 - L1-Z01 (on Level 1)**
Equipment Class ..... **UNDEF**
Air System Type ..... **SZCAV**

Number of zones **1**
Floor Area ..... **791.9** sqft
Location ..... **Syracuse Hancock Intl, NY, USA**

Sizing Calculation Information

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

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

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/sqft	Reheat Coil Capacity (MBH)	Reheat Coil Water gpm @ 20.0 F	Zone Htg Unit Coil Capacity (MBH)	Zone Htg Unit Water gpm @ 20.0 F	Mixing Box Fan Airflow (CFM)
L1-Z01	1123	1123	1.42	0.0	0.00	33.0	3.31	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (sqft)
L1-Z01	20.3	September 15:00	18.7	791.9

Space Loads and Airflows

Zone Name / Space Name	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (sqft)	Space CFM/sqft
L1-Z01						
L1-Z01	20.3	September 15:00	1123	18.7	791.9	1.42

Air System Heat Balance Summary for ALT1 - L1-Z01 (on Level 1)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023

Prepared by: HVAC Project_Syracuse University 20:43

Table 1. System Loads

	DESIGN COOLING - SEPTEMBER 15:00			DESIGN HEATING		
	OA DB / WB 83.2 F / 70.0 F			OA DB / WB -0.7 F / -2.2 F		
COMPONENT LOADS	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Zone Conditioning	-	17203	3654	-	19418	0
Plenum Load	-	0	0	-	0	0
Return Fan Load	1123 CFM	0	-	1123 CFM	0	-
Ventilation Load	87 CFM	378	1429	87 CFM	3397	1688
Supply Fan Load	1123 CFM	1665	-	1123 CFM	-1665	-
Zone Fan Coil Fans Load	-	0	-	-	0	-
>> Total System Loads	**-**	**19246**	**5083**	**-**	**21150**	**1688**
Central Cooling Coil	-	537	432	-	0	0
Central Heating Coil	-	0	-	-	30090	-
Precool Coil	-	18629	4852	-	-8807	0
Preheat Coil	-	0	-	-	0	-
Dehumidification Reheat Coil	-	0	-	-	0	-
Humidification	0.00 lb/hr	0	0	1.69 lb/hr	86	1639
Zone Heating Unit Coils	-	0	-	-	0	-
>> Total Conditioning	**-**	**19166**	**5284**	**-**	**21368**	**1639**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Table 2. Zone Heat Balance Loads

	DESIGN COOLING - SEPTEMBER 15:00			DESIGN HEATING		
	OA DB / WB 83.2 F / 70.0 F			OA DB / WB -0.7 F / -2.2 F		
Zone Heat Balance Component	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Exterior Wall Convection	769 sqft	4522	-	769 sqft	3760	-
Roof Convection	0 sqft	0	-	0 sqft	0	-
Window Convection	275 sqft	2616	-	275 sqft	5212	-
Skylight Convection	0 sqft	0	-	0 sqft	0	-
Door Convection	0 sqft	0	-	0 sqft	0	-
Floor Convection	792 sqft	6119	-	792 sqft	6980	-
Interior Wall Convection	0 sqft	0	-	0 sqft	0	-
Ceiling Convection	792 sqft	5333	-	792 sqft	2755	-
Overhead Lighting Convection	356 W	514	-	0 W	0	-
Task Lighting Convection	0 W	0	-	0 W	0	-
Electric Equipment Convection	198 W	507	-	0 W	0	-
People Convection	8	701	3603	0	0	0
Infiltration	0 CFM	0	0	0 CFM	0	0
Miscellaneous Equipment	-	0	0	-	0	0
Air Internal Energy Change	-	0		-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**20313**	**3603**	**-**	**18707**	**0**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Note 1: Surface convection line items show the combined effects of conductive heat gain to the surface and radiative heat gains absorbed at the surface which are then convected to room air.

Note 2: Lighting, equipment, and people line items include only the direct convective heat gain from the heat source to the room air. The radiative portion of the heat gain is first absorbed by surfaces in the room and then later convected from the surface to the air. Therefore the effect of the radiative portion of the heat gain is found in the surface convection line items.

Note 3: Solar heat gain is absorbed by surfaces in the room, re-radiated to other surfaces, and finally convected from the surfaces to room air. Therefore, the effect of solar heat gain is found in the surface convection line items.

DESIGN COOLING DAY AT SEPTEMBER 15:00

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	83.1	0.01295	87	400	378	1429
Air-to-Air Energy Recovery	Outlet	79.1	0.01295	87	400	385	0
Vent - Return Mixing	Outlet	75.3	0.00971	1123	2038	-	-
Preheat Coil	Outlet	75.3	0.00971	1123	2038	0	-
Precool Coil	Outlet	60.0	0.00882	1123	2038	18629	4852
Central Cooling Coil	Outlet	59.6	0.00874	1123	2038	537	432
Central Heating Coil	Outlet	59.6	0.00874	1123	2038	0	-
Supply Fan	Outlet	60.9	0.00874	1123	2038	1665	-
Humidifier	Outlet	60.9	0.00874	1123	2038	0	0
Dehumid. Reheat Coil	Outlet	60.9	0.00874	1123	2038	0	-
Cold Supply Duct	Outlet	60.9	0.00874	1123	2038	-	-
Zone Air	-	75.0	0.00942	1123	2176	17203	3654
Return Air	Outlet	75.0	0.00944	1123	2176	-	-
Return Fan	Outlet	75.0	0.00944	1123	2176	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.064 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4676.2 BTU/(hr-CFM)
Site Altitude = 413.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
L1-Z01	17196	Cooling	17212	75.0	1123	2176	0	0

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	-0.7	0.00035	87	400	-3397	-1688
Air-to-Air Energy Recovery	Outlet	34.7	0.00035	87	400	-3287	0
Vent - Return Mixing	Outlet	67.3	0.00438	1123	400	-	-
Preheat Coil	Outlet	67.3	0.00438	1123	400	0	-
Precool Coil	Outlet	60.0	0.00438	1123	400	8807	0
Central Cooling Coil	Outlet	60.0	0.00438	1123	400	0	0
Central Heating Coil	Outlet	84.9	0.00438	1123	400	30090	-
Supply Fan	Outlet	86.0	0.00438	1123	400	1665	-
Humidifier	Outlet	86.1	0.00472	1123	400	86	1639
Dehumid. Reheat Coil	Outlet	86.0	0.00438	1123	400	0	-
Cold Supply Duct	Outlet	86.1	0.00472	1123	400	-	-
Zone Air	-	70.0	0.00472	1123	400	-19418	0
Return Air	Outlet	70.0	0.00472	1123	400	-	-
Return Fan	Outlet	70.0	0.00472	1123	400	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.064 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4676.2 BTU/(hr-CFM)
Site Altitude = 413.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
L1-Z01	-19331	Heating	-19418	70.0	1123	400	0	0

Air System Sizing Summary for ALT1 - L2-Z01 (on Level 2)
(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023
Prepared by: HVAC Project_Syracuse University 20:43

Air System Information

Air System Name	**ALT1 - L2-Z01 (on Level 2)**	Number of zones	**1**
Equipment Class	**UNDEF**	Floor Area	**791.9** sqft
Air System Type	**SZCAV**	Location	**Syracuse Hancock Intl, NY, USA**

Sizing Calculation Information

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

Central Cooling Coil Sizing Data

Total coil load	**0.7**	Tons	Peak coil load occurs at	**March 18:00**	
Total coil load	**9.0**	MBH	OA DB / WB	**57.6 / 57.6**	F
Sensible coil load	**4.7**	MBH	Entering DB / WB	**60.0 / 55.2**	F
Coil CFM at peak load	**1182**	CFM	Leaving DB / WB	**56.3 / 52.3**	F
Sum of peak zone CFM	**1182**	CFM	Resulting RH	**51**	%
Sensible heat ratio	**0.523**		Design supply temp.	**58.0**	F
CFM/Ton	**1579.5**		Zone T-stat Check	**1 of 1**	OK
sqft/Ton	**1058.3**		Max zone temperature deviation	**0.0**	F
BTU/(hr sqft)	**11.3**				
Water flow @ 10.0 F rise	**1.80**	gpm			

Central Heating Coil Sizing Data

Max coil load	**27.3**	MBH	Load occurs at	**Design Heating**	
Coil CFM at Design Heating	**1182**	CFM	BTU/(hr sqft)	**34.5**	
Max coil CFM	**1182**	CFM	Ent. DB / Lvg DB	**60.0 / 81.5**	F
Water flow @ 20.0 F drop	**2.73**	gpm			

Precool Coil Sizing Data

Total coil load	**2.1**	Tons	Load occurs at	**July 16:00**	
Total coil load	**25.2**	MBH	OA DB / WB	**89.2 / 73.0**	F
Sensible coil load	**19.9**	MBH	Entering DB / WB	**75.5 / 63.6**	F
Coil CFM at July 16:00	**1182**	CFM	Leaving DB / WB	**60.0 / 56.5**	F
Max coil CFM	**1182**	CFM			
Sensible heat ratio	**0.790**				
Water flow @ 10.0 F rise	**5.04**	gpm			

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Humidifier Sizing Data

Max steam flow at Design Heating	**1.69**	lb/hr	Air mass flow	**5239.12**	lb/hr
Airflow Rate	**1182**	CFM	Moisture gain	**.00032**	lb/lb

Dehumidification Reheat Coil Sizing Data

Max coil load	**4.2**	MBH	Load occurs at	**March 18:00**	
Coil CFM at March 18:00	**1182**	CFM	BTU/(hr sqft)	**5.3**	
Max coil CFM	**1182**	CFM	Ent. DB / Lvg DB	**58.3 / 61.6**	F
Water flow @ 20.0 F drop	**0.42**	gpm			

Supply Fan Sizing Data

Design CFM	**1182**	CFM	Fan motor BHP	**0.65**	BHP
Design CFM/sqft	**1.49**	CFM/sqft	Fan motor kW	**0.51**	kW
			Fan total static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM	**1182**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**1164**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/sqft	**1.49**	CFM/sqft	Fan total static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**87**	CFM	CFM/person	**11.00**	CFM/person
CFM/sqft	**0.11**	CFM/sqft			

Zone Sizing Summary for ALT1 - L2-Z01 (on Level 2)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023

Prepared by: HVAC Project_Syracuse University 20:43

Air System Information

Air System Name ..... **ALT1 - L2-Z01 (on Level 2)**
Equipment Class ..... **UNDEF**
Air System Type ..... **SZCAV**

Number of zones **1**
Floor Area ..... **791.9** sqft
Location ..... **Syracuse Hancock Intl, NY, USA**

Sizing Calculation Information

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

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

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/sqft	Reheat Coil Capacity (MBH)	Reheat Coil Water gpm @ 20.0 F	Zone Htg Unit Coil Capacity (MBH)	Zone Htg Unit Water gpm @ 20.0 F	Mixing Box Fan Airflow (CFM)
L2-Z01	1182	1182	1.49	0.0	0.00	0.0	0.00	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (sqft)
L2-Z01	21.4	September 15:00	14.9	791.9

Space Loads and Airflows

Zone Name / Space Name	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (sqft)	Space CFM/sqft
L2-Z01						
L2-Z01	21.4	September 15:00	1182	14.9	791.9	1.49

Air System Heat Balance Summary for ALT1 - L2-Z01 (on Level 2)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023

Prepared by: HVAC Project_Syracuse University 20:43

Table 1. System Loads

	DESIGN COOLING - MARCH 18:00			DESIGN HEATING		
	OA DB / WB 57.6 F / 57.6 F			OA DB / WB -0.7 F / -2.2 F		
COMPONENT LOADS	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Zone Conditioning	-	11644	6867	-	16004	0
Plenum Load	-	0	0	-	0	0
Return Fan Load	1182 CFM	0	-	1182 CFM	0	-
Ventilation Load	407 CFM	-4604	2662	87 CFM	3397	1688
Supply Fan Load	1182 CFM	1752	-	1182 CFM	-1752	-
Zone Fan Coil Fans Load	-	0	-	-	0	-
>> Total System Loads	**-**	**8791**	**9529**	**-**	**17649**	**1688**
Central Cooling Coil	-	4700	4279	-	0	0
Central Heating Coil	-	-1228	-	-	27307	-
Precool Coil	-	8872	3808	-	-9441	0
Preheat Coil	-	0	-	-	0	-
Dehumidification Reheat Coil	-	-4202	-	-	0	-
Humidification	0.00 lb/hr	0	0	1.69 lb/hr	88	1639
>> Total Conditioning	**-**	**8143**	**8087**	**-**	**17955**	**1639**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Table 2. Zone Heat Balance Loads

	DESIGN COOLING - MARCH 18:00			DESIGN HEATING		
	OA DB / WB 57.6 F / 57.6 F			OA DB / WB -0.7 F / -2.2 F		
Zone Heat Balance Component	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Exterior Wall Convection	768 sqft	1816	-	768 sqft	3784	-
Roof Convection	0 sqft	0	-	0 sqft	0	-
Window Convection	275 sqft	-542	-	275 sqft	5078	-
Skylight Convection	0 sqft	0	-	0 sqft	0	-
Door Convection	0 sqft	0	-	0 sqft	0	-
Floor Convection	792 sqft	2766	-	792 sqft	3051	-
Interior Wall Convection	0 sqft	0	-	0 sqft	0	-
Ceiling Convection	792 sqft	2057	-	792 sqft	3020	-
Overhead Lighting Convection	356 W	514	-	0 W	0	-
Task Lighting Convection	0 W	0	-	0 W	0	-
Electric Equipment Convection	198 W	507	-	0 W	0	-
People Convection	8	701	3603	0	0	0
Infiltration	0 CFM	0	0	0 CFM	0	0
Miscellaneous Equipment	-	0	0	-	0	0
Air Internal Energy Change	-	0		-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**7818**	**3603**	**-**	**14934**	**0**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Note 1: Surface convection line items show the combined effects of conductive heat gain to the surface and radiative heat gains absorbed at the surface which are then convected to room air.

Note 2: Lighting, equipment, and people line items include only the direct convective heat gain from the heat source to the room air. The radiative portion of the heat gain is first absorbed by surfaces in the room and then later convected from the surface to the air. Therefore the effect of the radiative portion of the heat gain is found in the surface convection line items.

Note 3: Solar heat gain is absorbed by surfaces in the room, re-radiated to other surfaces, and finally convected from the surfaces to room air. Therefore, the effect of solar heat gain is found in the surface convection line items.

System Psychrometrics for ALT1 - L2-Z01 (on Level 2)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023

Prepared by: HVAC Project_Syracuse University 20:43

DESIGN COOLING DAY AT MARCH 18:00

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	57.4	0.01016	407	400	-4604	2662
Air-to-Air Energy Recovery	Outlet	60.1	0.01016	407	400	-1078	0
Vent - Return Mixing	Outlet	66.9	0.00893	1182	566	-	-
Preheat Coil	Outlet	66.9	0.00893	1182	566	0	-
Precool Coil	Outlet	60.0	0.00827	1182	566	8872	3808
Central Cooling Coil	Outlet	56.3	0.00752	1182	566	4700	4279
Central Heating Coil	Outlet	57.3	0.00752	1182	566	5430	-
Supply Fan	Outlet	58.3	0.00752	1182	566	1752	-
Humidifier	Outlet	61.6	0.00752	1182	566	0	0
Dehumid. Reheat Coil	Outlet	61.6	0.00752	1182	566	4202	-
Cold Supply Duct	Outlet	61.6	0.00752	1182	566	-	-
Zone Air	-	70.5	0.00836	1182	674	11644	6867
Return Air	Outlet	70.8	0.00876	1182	639	-	-
Return Fan	Outlet	70.8	0.00876	1182	639	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.064 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4676.2 BTU/(hr-CFM)
Site Altitude = 413.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
L2-Z01	0	Deadband	11413	70.5	1182	674	0	0

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	-0.7	0.00035	87	400	-3397	-1688
Air-to-Air Energy Recovery	Outlet	34.7	0.00035	87	400	-3287	0
Vent - Return Mixing	Outlet	67.4	0.00440	1182	400	-	-
Preheat Coil	Outlet	67.4	0.00440	1182	400	0	-
Precool Coil	Outlet	60.0	0.00440	1182	400	9441	0
Central Cooling Coil	Outlet	60.0	0.00440	1182	400	0	0
Central Heating Coil	Outlet	81.5	0.00440	1182	400	27307	-
Supply Fan	Outlet	82.5	0.00440	1182	400	1752	-
Humidifier	Outlet	82.6	0.00472	1182	400	88	1639
Dehumid. Reheat Coil	Outlet	82.5	0.00440	1182	400	0	-
Cold Supply Duct	Outlet	82.6	0.00472	1182	400	-	-
Zone Air	-	70.0	0.00472	1182	400	-16004	0
Return Air	Outlet	70.0	0.00472	1182	400	-	-
Return Fan	Outlet	70.0	0.00472	1182	400	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.064 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4676.2 BTU/(hr-CFM)
Site Altitude = 413.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
L2-Z01	-15914	Heating	-16004	70.0	1182	400	0	0

Air System Sizing Summary for ALT1 - L3-Z01 (on Level 3)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023
Prepared by: HVAC Project_Syracuse University 20:43

Air System Information

Air System Name	**ALT1 - L3-Z01 (on Level 3)**	Number of zones	**1**	
Equipment Class	**UNDEF**	Floor Area	**791.9**	sqft
Air System Type	**SZCAV**	Location	**Syracuse Hancock Intl, NY, USA**	

Sizing Calculation Information

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

Central Cooling Coil Sizing Data

Total coil load	**0.3**	Tons	Peak coil load occurs at	**September 15:00**	
Total coil load	**4.0**	MBH	OA DB / WB	**83.2 / 70.0**	F
Sensible coil load	**2.3**	MBH	Entering DB / WB	**60.0 / 55.4**	F
Coil CFM at peak load	**1165**	CFM	Leaving DB / WB	**58.1 / 54.1**	F
Sum of peak zone CFM	**1165**	CFM	Resulting RH	**48**	%
Sensible heat ratio	**0.578**		Design supply temp.	**58.0**	F
CFM/Ton	**3458.1**		Zone T-stat Check	**1 of 1**	OK
sqft/Ton	**2351.4**		Max zone temperature deviation	**0.0**	F
BTU/(hr sqft)	**5.1**				
Water flow @ 10.0 F rise	**0.81**	gpm			

Central Heating Coil Sizing Data

Max coil load	**28.6**	MBH	Load occurs at	**Design Heating**	
Coil CFM at Design Heating	**1165**	CFM	BTU/(hr sqft)	**36.1**	
Max coil CFM	**1165**	CFM	Ent. DB / Lvg DB	**60.0 / 82.9**	F
Water flow @ 20.0 F drop	**2.86**	gpm			

Precool Coil Sizing Data

Total coil load	**2.1**	Tons	Load occurs at	**July 15:00**	
Total coil load	**24.8**	MBH	OA DB / WB	**89.2 / 73.0**	F
Sensible coil load	**19.6**	MBH	Entering DB / WB	**75.5 / 63.6**	F
Coil CFM at July 15:00	**1165**	CFM	Leaving DB / WB	**60.0 / 56.5**	F
Max coil CFM	**1165**	CFM			
Sensible heat ratio	**0.789**				
Water flow @ 10.0 F rise	**4.97**	gpm			

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Humidifier Sizing Data

Max steam flow at Design Heating	**1.69**	lb/hr	Air mass flow	**5162.74**	lb/hr
Airflow Rate	**1165**	CFM	Moisture gain	**.00033**	lb/lb

Dehumidification Reheat Coil Sizing Data

Max coil load	**0.3**	MBH	Load occurs at	**March 18:00**	
Coil CFM at March 18:00	**1165**	CFM	BTU/(hr sqft)	**0.4**	
Max coil CFM	**1165**	CFM	Ent. DB / Lvg DB	**61.8 / 62.0**	F
Water flow @ 20.0 F drop	**0.03**	gpm			

Supply Fan Sizing Data

Design CFM	**1165**	CFM	Fan motor BHP	**0.64**	BHP
Design CFM/sqft	**1.47**	CFM/sqft	Fan motor kW	**0.51**	kW
			Fan total static	**2.00**	in wg

Return Fan Sizing Data

Actual max CFM	**1165**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**1147**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/sqft	**1.47**	CFM/sqft	Fan total static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**87**	CFM	CFM/person	**11.00**	CFM/person
CFM/sqft	**0.11**	CFM/sqft			

Zone Sizing Summary for ALT1 - L3-Z01 (on Level 3)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023

Prepared by: HVAC Project_Syracuse University 20:43

Air System Information

Air System Name ..... **ALT1 - L3-Z01 (on Level 3)**
Equipment Class ..... **UNDEF**
Air System Type ..... **SZCAV**

Number of zones **1**
Floor Area ..... **791.9** sqft
Location ..... **Syracuse Hancock Intl, NY, USA**

Sizing Calculation Information

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

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

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/sqft	Reheat Coil Capacity (MBH)	Reheat Coil Water gpm @ 20.0 F	Zone Htg Unit Coil Capacity (MBH)	Zone Htg Unit Water gpm @ 20.0 F	Mixing Box Fan Airflow (CFM)
L3-Z01	1165	1165	1.47	0.0	0.00	0.0	0.00	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (sqft)
L3-Z01	21.1	September 15:00	16.5	791.9

Space Loads and Airflows

Zone Name / Space Name	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (sqft)	Space CFM/sqft
L3-Z01						
L3-Z01	21.1	September 15:00	1165	16.5	791.9	1.47

Air System Heat Balance Summary for ALT1 - L3-Z01 (on Level 3)

(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023

Prepared by: HVAC Project_Syracuse University 20:43

Table 1. System Loads

	DESIGN COOLING - SEPTEMBER 15:00			DESIGN HEATING		
	OA DB / WB 83.2 F / 70.0 F			OA DB / WB -0.7 F / -2.2 F		
COMPONENT LOADS	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Zone Conditioning	-	19810	3446	-	17501	0
Plenum Load	-	0	0	-	0	0
Return Fan Load	1165 CFM	0	-	1165 CFM	0	-
Ventilation Load	87 CFM	377	1710	87 CFM	3397	1688
Supply Fan Load	1165 CFM	1727	-	1165 CFM	-1727	-
Zone Fan Coil Fans Load	-	0	-	-	0	-
>> Total System Loads	**-**	**21914**	**5157**	**-**	**19171**	**1688**
Central Cooling Coil	-	2336	1705	-	0	0
Central Heating Coil	-	0	-	-	28610	-
Precool Coil	-	19309	3647	-	-9255	0
Preheat Coil	-	0	-	-	0	-
Dehumidification Reheat Coil	-	0	-	-	0	-
Humidification	0.00 lb/hr	0	0	1.69 lb/hr	87	1639
>> Total Conditioning	**-**	**21645**	**5352**	**-**	**19442**	**1639**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Table 2. Zone Heat Balance Loads

	DESIGN COOLING - SEPTEMBER 15:00			DESIGN HEATING		
	OA DB / WB 83.2 F / 70.0 F			OA DB / WB -0.7 F / -2.2 F		
Zone Heat Balance Component	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Exterior Wall Convection	768 sqft	4592	-	768 sqft	3904	-
Roof Convection	0 sqft	0	-	0 sqft	0	-
Window Convection	275 sqft	2675	-	275 sqft	5194	-
Skylight Convection	0 sqft	0	-	0 sqft	0	-
Door Convection	0 sqft	0	-	0 sqft	0	-
Floor Convection	792 sqft	6676	-	792 sqft	3112	-
Interior Wall Convection	0 sqft	0	-	0 sqft	0	-
Ceiling Convection	792 sqft	5399	-	792 sqft	4312	-
Overhead Lighting Convection	356 W	514	-	0 W	0	-
Task Lighting Convection	0 W	0	-	0 W	0	-
Electric Equipment Convection	198 W	507	-	0 W	0	-
People Convection	8	701	3603	0	0	0
Infiltration	0 CFM	0	0	0 CFM	0	0
Miscellaneous Equipment	-	0	0	-	0	0
Air Internal Energy Change	-	0		-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**21064**	**3603**	**-**	**16522**	**0**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Note 1: Surface convection line items show the combined effects of conductive heat gain to the surface and radiative heat gains absorbed at the surface which are then convected to room air.

Note 2: Lighting, equipment, and people line items include only the direct convective heat gain from the heat source to the room air. The radiative portion of the heat gain is first absorbed by surfaces in the room and then later convected from the surface to the air. Therefore the effect of the radiative portion of the heat gain is found in the surface convection line items.

Note 3: Solar heat gain is absorbed by surfaces in the room, re-radiated to other surfaces, and finally convected from the surfaces to room air. Therefore, the effect of solar heat gain is found in the surface convection line items.

DESIGN COOLING DAY AT SEPTEMBER 15:00

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	83.1	0.01295	87	400	377	1710
Air-to-Air Energy Recovery	Outlet	79.1	0.01295	87	400	384	0
Vent - Return Mixing	Outlet	75.3	0.00906	1165	2041	-	-
Preheat Coil	Outlet	75.3	0.00906	1165	2041	0	-
Precool Coil	Outlet	60.0	0.00842	1165	2041	19309	3647
Central Cooling Coil	Outlet	58.1	0.00811	1165	2041	2336	1705
Central Heating Coil	Outlet	58.1	0.00811	1165	2041	0	-
Supply Fan	Outlet	59.3	0.00811	1165	2041	1727	-
Humidifier	Outlet	59.3	0.00811	1165	2041	0	0
Dehumid. Reheat Coil	Outlet	59.3	0.00811	1165	2041	0	-
Cold Supply Duct	Outlet	59.3	0.00811	1165	2041	-	-
Zone Air	-	75.0	0.00875	1165	2174	19810	3446
Return Air	Outlet	75.0	0.00875	1165	2174	-	-
Return Fan	Outlet	75.0	0.00875	1165	2174	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.064 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4676.2 BTU/(hr-CFM)
Site Altitude = 413.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
L3-Z01	19810	Cooling	19810	75.0	1165	2174	0	0

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	-0.7	0.00035	87	400	-3397	-1688
Air-to-Air Energy Recovery	Outlet	34.7	0.00035	87	400	-3287	0
Vent - Return Mixing	Outlet	67.4	0.00439	1165	400	-	-
Preheat Coil	Outlet	67.4	0.00439	1165	400	0	-
Precool Coil	Outlet	60.0	0.00439	1165	400	9255	0
Central Cooling Coil	Outlet	60.0	0.00439	1165	400	0	0
Central Heating Coil	Outlet	82.9	0.00439	1165	400	28610	-
Supply Fan	Outlet	83.9	0.00439	1165	400	1727	-
Humidifier	Outlet	84.0	0.00472	1165	400	87	1639
Dehumid. Reheat Coil	Outlet	83.9	0.00439	1165	400	0	-
Cold Supply Duct	Outlet	84.0	0.00472	1165	400	-	-
Zone Air	-	70.0	0.00472	1165	400	-17501	0
Return Air	Outlet	70.0	0.00472	1165	400	-	-
Return Fan	Outlet	70.0	0.00472	1165	400	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.064 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4676.2 BTU/(hr-CFM)
Site Altitude = 413.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
L3-Z01	-17413	Heating	-17501	70.0	1165	400	0	0

Plant Sizing Summary for Default Plant
(In Alternative: ALT1 - Sample)

Project: MAE_553. HVAC PROJECT 12-04-2023
Prepared by: HVAC Project_Syracuse University 20:43

1. Plant Information:

Plant ..... **Default Plant**
Type ..... **Generic Heat Recovery**
Design Weather ..... **Syracuse Hancock Intl, NY, USA**

2. Cooling Plant Sizing Data:

Maximum Plant Load ..... **6.6** Tons
Load occurs at ..... **August 15:00**
sqft/Ton ..... **358.6** sqft/Ton
Floor area served by plant ..... **2375.6** sqft

3. Coincident Cooling Loads for August 15:00

Air System	System Cooling Coil Load [Tons]
ALT1 - L1-Z01 (on Level 1)	2.0
ALT1 - L2-Z01 (on Level 2)	2.3
ALT1 - L3-Z01 (on Level 3)	2.3

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

5. Heating Plant Sizing Data:

Maximum Plant Load ..... **123.6** MBH
Load occurs at ..... **January 0:00**
BTU/(hr sqft) ..... **52.0** BTU/(hr sqft)
Floor area served by plant ..... **2375.6** sqft

6. Coincident Heating Loads for January 0:00

Air System	System Heating Coil Load [MBH]
ALT1 - L1-Z01 (on Level 1)	31.8
ALT1 - L2-Z01 (on Level 2)	29.0
ALT1 - L3-Z01 (on Level 3)	30.3

Air system loads are for coils whose heating source is January 0:00

Coincident Service Hot Water Load ..... **32.4** MBH

CONCLUSION:

- **Personally, evaluating my house's design using the CARRIER HAP (Hourly Analysis Program) for comprehensive sizing reports.**

- **If year-round climate control is a priority, incorporating air conditioning, as the house is already equipped with a heating system, without necessitating a heat pump; however, opting for a heat pump would notably contribute to lowering carbon emissions—an imperative step towards eliminating reliance on fossil fuels.**

- **If the landlord is considering renovations in the future, it would be more practical to choose a ducted heat pump, considering the existing ductwork, rather than exploring a ductless heat pump.**

- **Acknowledging the importance of regular HVAC maintenance for optimal heating system performance.**

- **Emphasizing the benefits of smart thermostats for convenience and energy savings and underscoring the significance of proper insulation and ventilation for consistent indoor comfort.**

- **Recognizing the value of consulting with an HVAC professional to tailor solutions to the specific needs, ensuring a comfortable living space.**