Design of HVAC Cooling System using HAP

Semester 6 CEP

Introduction to Finite Element Method

DHA Suffa University

Department of Mechanical Engineering

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Problem Statement

This complex engineering problem aims to design an HVAC (cooling) system using Hourly Analysis Program (HAP) for your house [of any group member] located in Karachi, Pakistan. In case, you are living in a multi-story house, limit this designing process to a single story, which is more commonly in use.

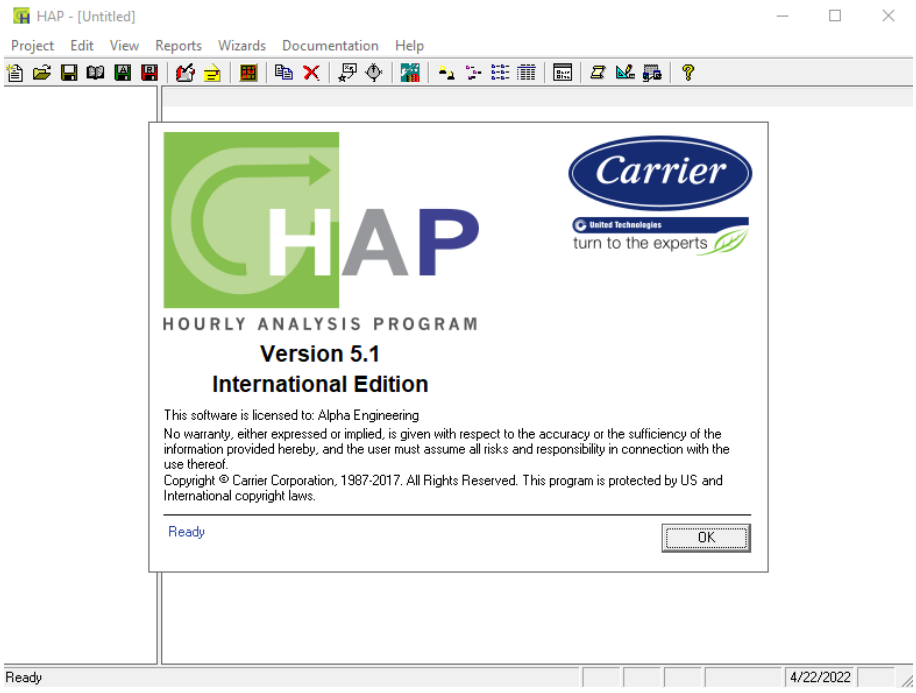
The scope of the project must, at a minimum deliver complete cooling load calculations, as per the relevant ASHRAE standards. The students must select and size central cooling equipment for the given space. The cooling system has to be designed to provide the best thermal human comfort by ensuring the minimum requirements of indoor air quality (IAQ) are met.

Software Details

Carrier's **Hourly Analysis Program** is two powerful tools in one package - versatile features for designing HVAC systems for commercial buildings AND powerful energy analysis capabilities for comparing energy consumption and energy costs of design alternatives.

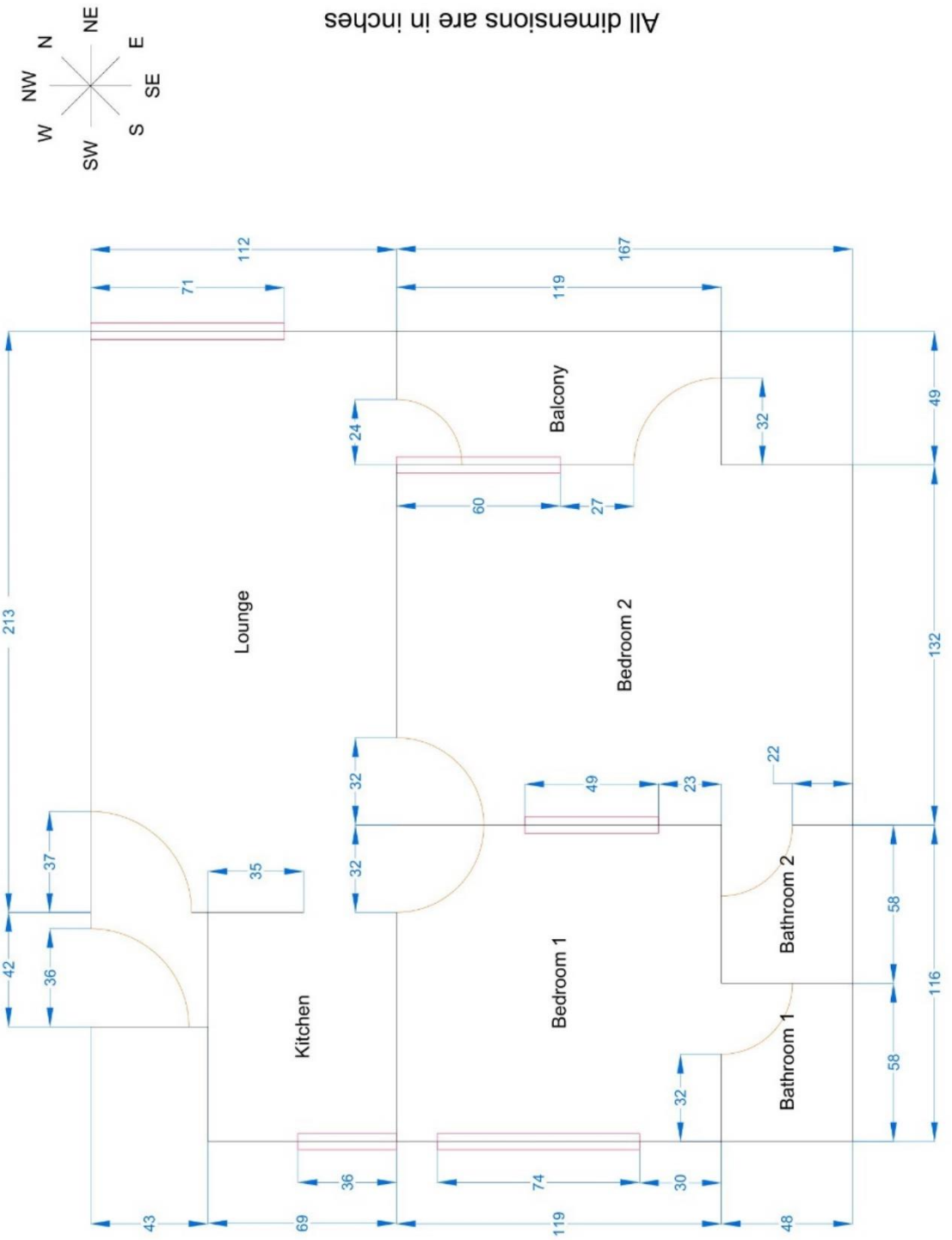
By combining both tools in one package, significant time savings are achieved. Input data and results from system design calculations can be used directly in energy modeling studies.

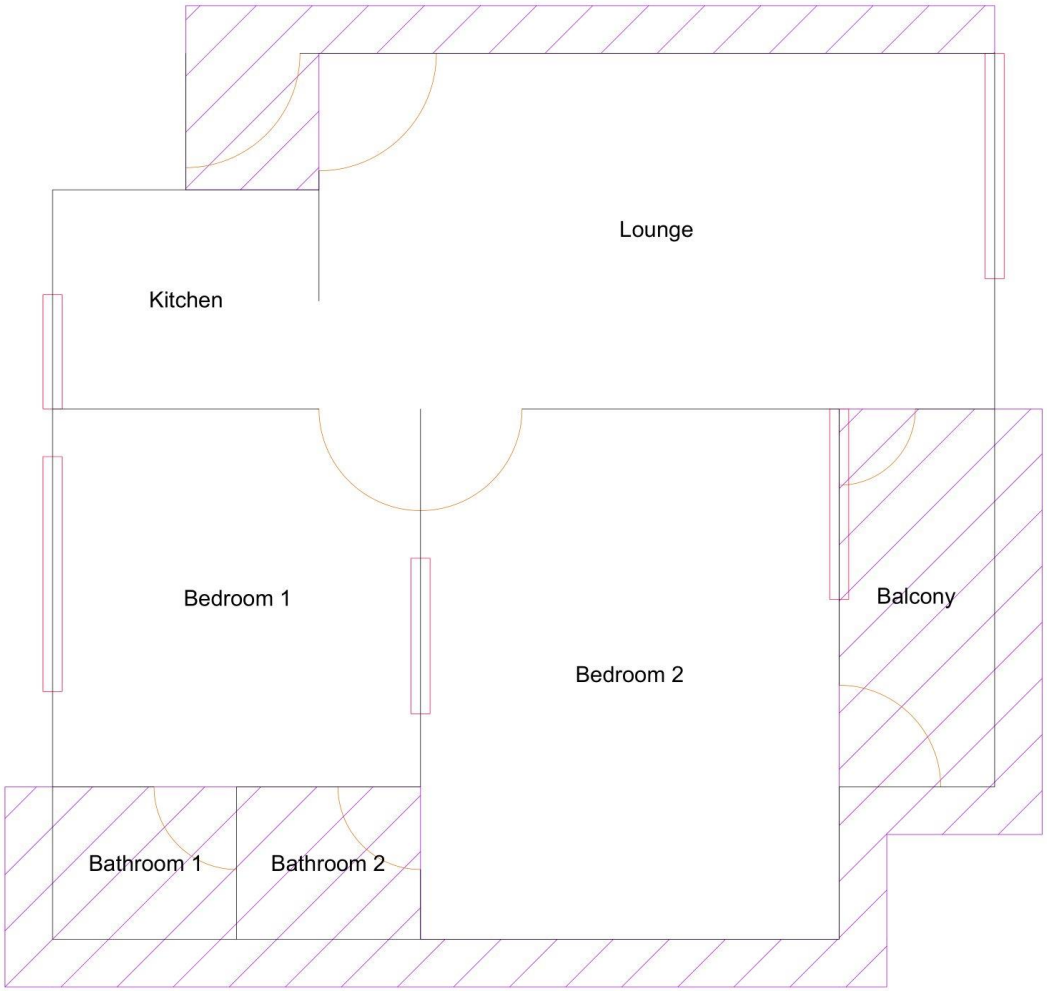
HAP is designed for consulting engineers, design/build contractors, HVAC contractors, facility engineers and other professionals involved in the design and analysis of commercial building HVAC systems.

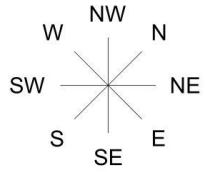


Tasks Related to HVAC System Design

I. Construction Plan




Lounge
Kitchen
Bedroom 1
Bedroom 2
Balcony
Bathroom 1
Bathroom 2


NW
W
N
SW
NE
S
E
SE

Legend (Color Codes)	
Black	Apartment Wall
Blue	Dimension
Brown	Door
Red	Window
Purple	Unconditioned Space

Vertical Dimensions (not included in the Plan above)	
Apartment Ceiling Height	105 in = 8.8 ft
Bedroom 1 Window Height	49 in
Bedroom 2 Window Height	48 in
Bedroom 1 & 2 Window Height	36 in
Kitchen Window Height	36 in
Lounge Window Height	48 in
Door Height	73 in

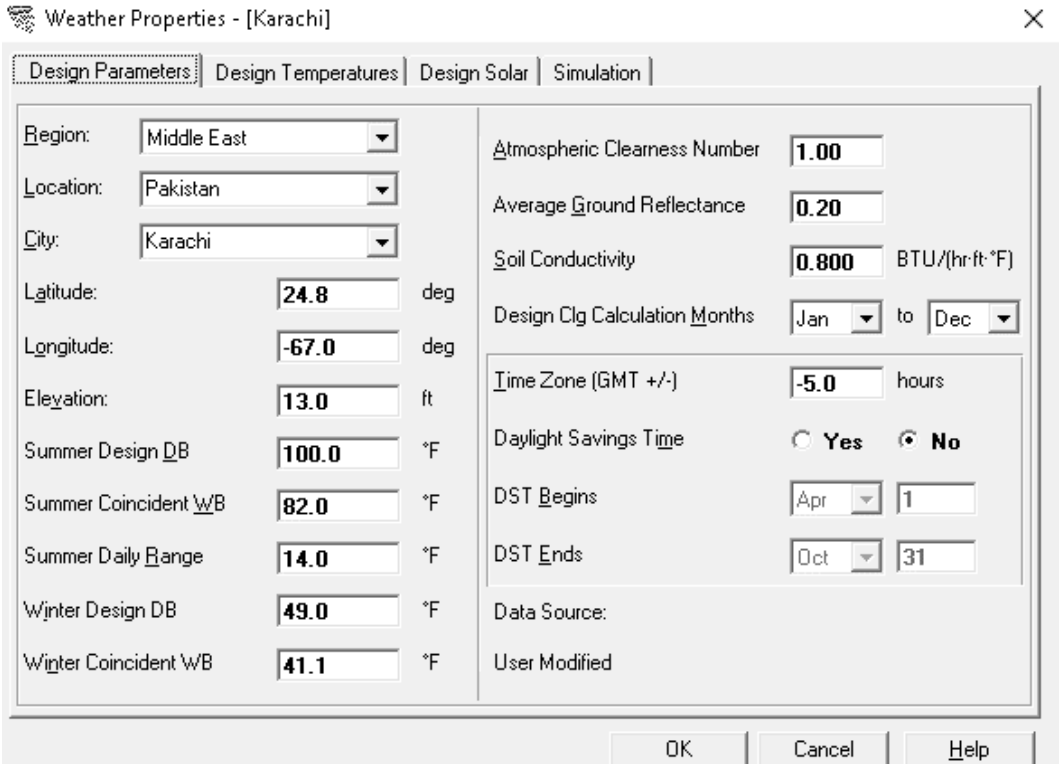
Rooms/Spaces Data	
Bedroom 1	
Bedroom 1 Floor Area	$= \frac{119 \times 116}{12 \times 12} = 95.9\ ft^2$
Bedroom 1 Lightning Wattage	$= 3\ Lights\ (13\ W)\ + 1\ Tubelight\ (18\ W) = 57\ W$
Bedroom 1 Fan Wattage	$= 1\ Fan\ (50\ W) = 50\ W$
Bedroom 1 Occupancy	$= 2\ People$
Bedroom 1 Exposure Wall Gross Area (SW)	$= \frac{119 \times 105}{12 \times 12} = 86.8\ ft^2$
Bedroom 1 Roof Area	$= \frac{119 \times 116}{12 \times 12} = 95.9\ ft^2$
Bedroom 1 Partition Area	$= \frac{116 \times 105}{12 \times 12} = 84.6\ ft^2$
Bedroom 2	
Bedroom 2 Floor Area	$= \frac{167 \times 132}{12 \times 12} = 153.1\ ft^2$

Bedroom 2 Lightning Wattage	$= 13\ Lights\ (13\ W) = 169.0\ W$
Bedroom 2 Fan Wattage	$= 1\ Fan\ (50\ W) = 50\ W$
Bedroom 2 Occupancy	$= 3\ People$
Bedroom 2 Exposure Wall Gross Area	$= 0\ ft^2$
Bedroom 2 Roof Area	$= \frac{167 \times 132}{12 \times 12} = 153.1\ ft^2$
Bedroom 2 Partition Area	$= \frac{48 \times 105}{12 \times 12} + \frac{132 \times 105}{12 \times 12} + \frac{167 \times 105}{12 \times 12} = 253.0\ ft^2$
Kitchen	
Kitchen Floor Area	$= \frac{84 \times 69}{12 \times 12} = 40.3\ ft^2$
Kitchen Lightning Wattage	$= 1\ Lights\ (13\ W)\ + 1\ Tubelight\ (18\ W) = 31\ W$
Kitchen Fan Wattage	$= 0\ W$
Kitchen Occupancy	$= 2\ People$
Kitchen Exposure Wall Gross Area (SW)	$= \frac{69 \times 105}{12 \times 12} = 50.3\ ft^2$
Kitchen Exposure Wall Gross Area (NW)	$= \frac{42 \times 105}{12 \times 12} = 30.6\ ft^2$
Kitchen Roof Area	$= \frac{84 \times 69}{12 \times 12} = 40.3\ ft^2$
Kitchen Partition Area	$= \frac{42 \times 105}{12 \times 12} = 30.6\ ft^2$
Lounge	
Lounge Floor Area	$= \frac{213 \times 112}{12 \times 12} = 165.7\ ft^2$
Lounge Lightning Wattage	$= 3\ Lights\ (13\ W)\ + 1\ Tubelight\ (18\ W) = 57\ W$
Lounge Fan Wattage	$= 1\ Fan\ (50\ W) = 50\ W$
Lounge Occupancy	$= 5\ People$
Lounge Exposure Wall Gross Area (NE)	$= \frac{112 \times 105}{12 \times 12} = 81.7\ ft^2$

Lounge Roof Area	$= \frac{213 \times 112}{12 \times 12} = 165.7\ ft^2$
Lounge Partition Area	$= \frac{43 \times 105}{12 \times 12} + \frac{213 \times 105}{12 \times 12} + \frac{49 \times 105}{12 \times 12} = 222.4\ ft^2$

II. Selection of Input Parameters and Operating Schedule

a. Outdoor Design Temperature



Weather Properties - [Karachi]

Design Parameters | Design Temperatures | Design Solar | Simulation

Monthly Max/Min

Month	Dry Bulb Max	Dry Bulb Min	Wet Bulb Max	Wet Bulb Min
Jan	89.8	75.8	75.8	72.0
Feb	91.8	77.8	76.8	73.0
Mar	94.8	80.8	79.0	75.4
Apr	95.8	81.8	79.8	76.3
May	97.0	83.0	80.8	77.4
Jun	99.0	85.0	82.0	78.7
Jul	100.0	86.0	82.0	78.7
Aug	100.0	86.0	82.0	78.7
Sep	98.0	84.0	81.0	77.6
Oct	96.0	82.0	80.0	76.5
Nov	92.8	78.8	78.8	75.2
Dec	90.8	76.8	76.8	73.0

Hourly Detail View

Hour	Jan DB	Jan WB	Feb DB	Feb WB
0000	78.3	72.7	80.3	73.8
0100	77.6	72.5	79.6	73.6
0200	76.9	72.3	78.9	73.4
0300	76.4	72.1	78.4	73.2
0400	75.9	72.0	77.9	73.1
0500	75.8	72.0	77.8	73.0
0600	76.1	72.0	78.1	73.1
0700	76.8	72.2	78.8	73.3
0800	78.0	72.6	80.0	73.7
0900	79.9	73.1	81.9	74.2
1000	82.0	73.7	84.0	74.7
1100	84.3	74.3	86.3	75.4
1200	86.6	74.9	88.6	76.0
1300	88.3	75.4	90.3	76.4

OK | Cancel | Help

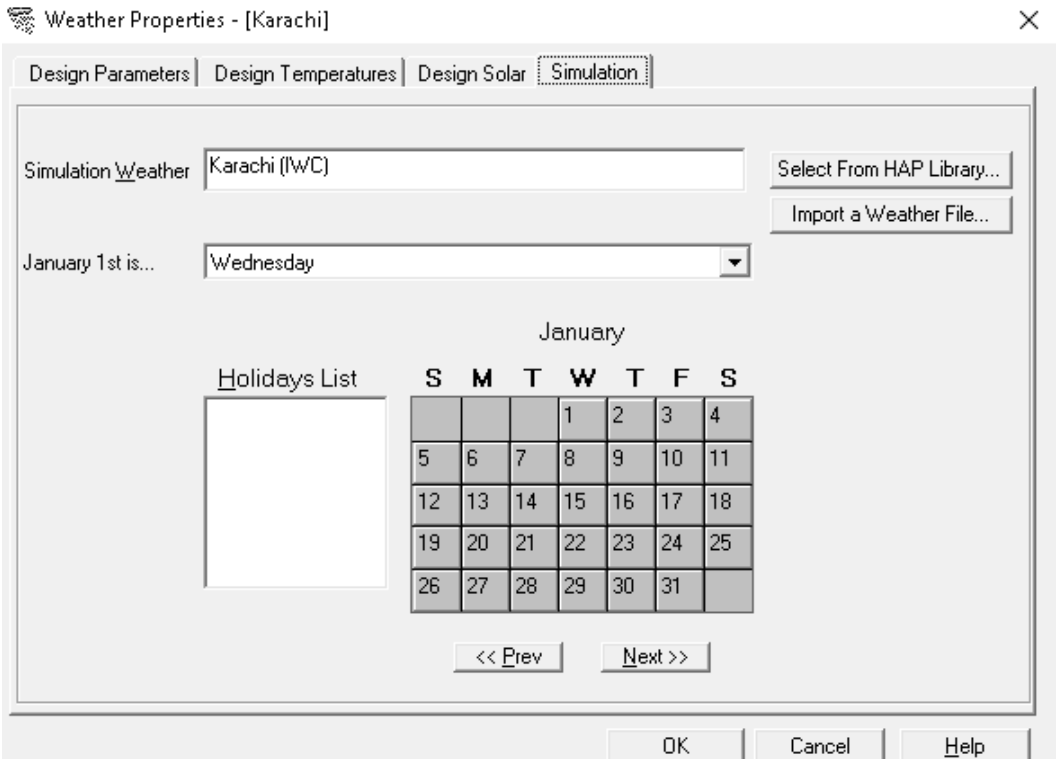
Weather Properties - [Karachi]

Design Parameters | Design Temperatures | Design Solar | Simulation

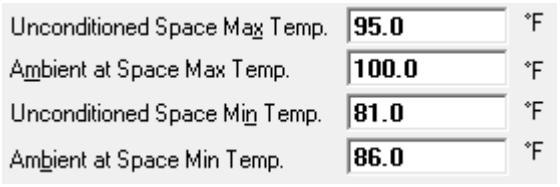
Design Day Maximum Solar Heat Gains BTU/(hr·ft²)

Month	Multiplier	N	NNE	NE	ENE	E	ESE	SE	SSE	S
Jan	1.00	26.7	26.7	42.7	121.5	193.2	240.2	249.8	240.9	229
Feb	1.00	29.9	29.9	82.9	161.4	214.8	247.9	242.6	215.1	194
Mar	1.00	33.4	41.7	125.3	194.0	231.7	236.0	215.8	170.9	140
Apr	1.00	36.7	87.3	157.3	208.3	227.9	212.8	170.7	110.6	78
May	1.00	42.6	117.3	176.5	213.3	218.4	190.9	134.4	70.0	48
Jun	1.00	54.7	125.9	183.4	213.7	212.2	179.3	119.4	57.1	43
Jul	1.00	44.3	115.0	176.6	210.8	213.7	184.6	132.0	68.5	47
Aug	1.00	38.3	84.5	155.3	202.4	219.4	203.3	164.9	106.8	76
Sept	1.00	34.5	42.1	115.0	183.4	222.3	227.3	207.2	165.6	138
Oct	1.00	30.7	30.7	73.8	156.7	212.8	235.9	235.6	208.9	189
Nov	1.00	27.0	27.0	37.2	124.8	189.5	233.2	250.0	238.8	226
Dec	1.00	25.2	25.2	28.2	108.9	178.6	232.9	250.8	247.9	238

OK | Cancel | Help



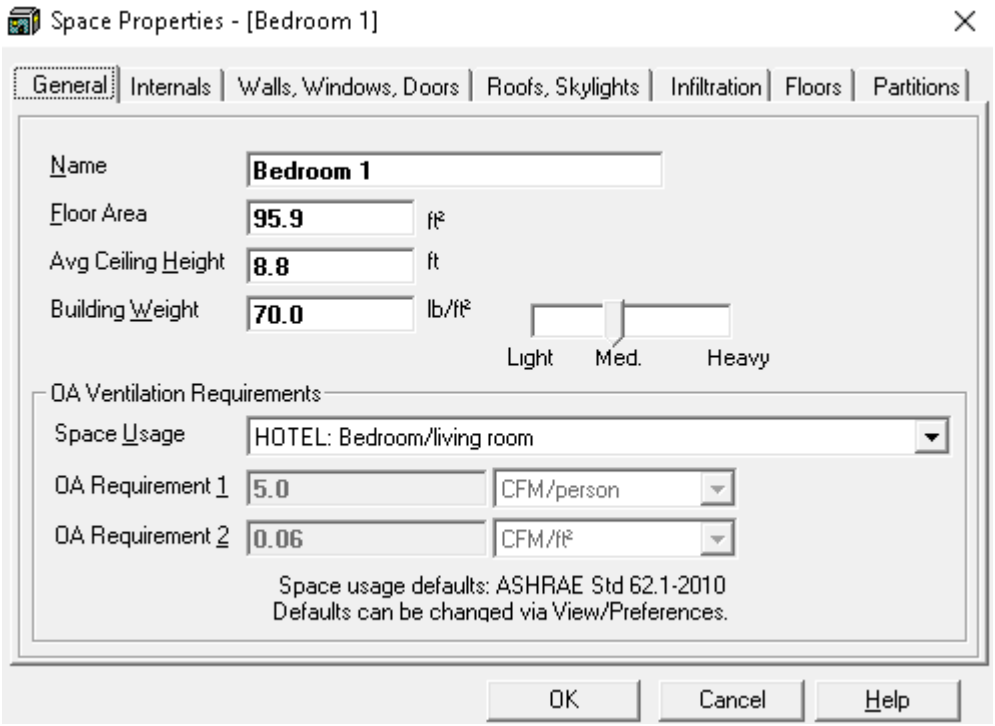
b. Indoor Design Temperature

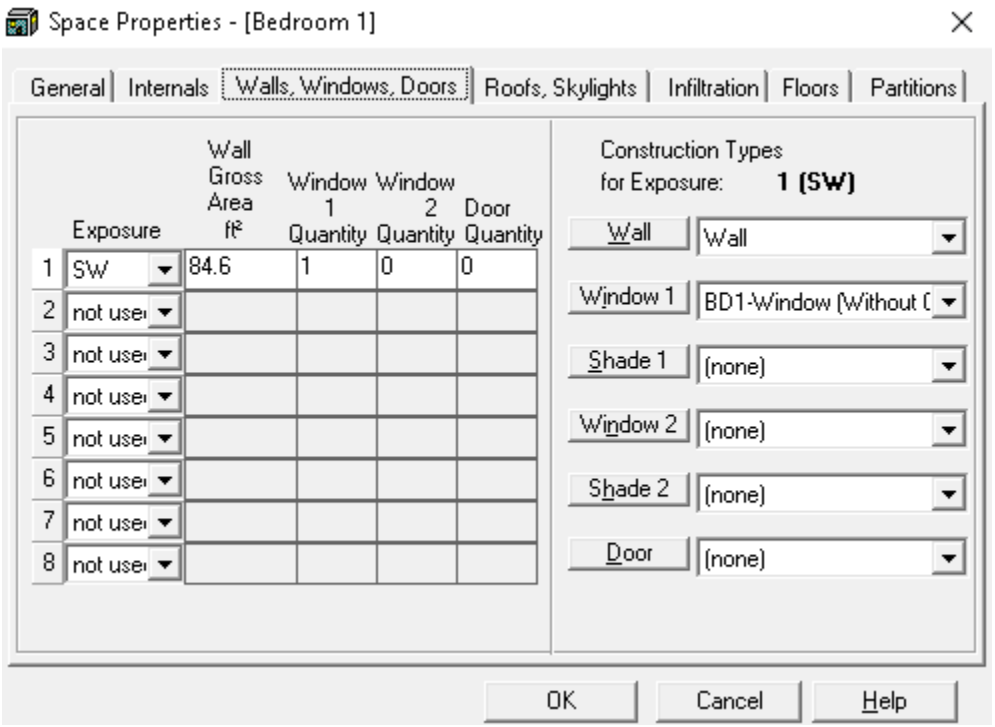


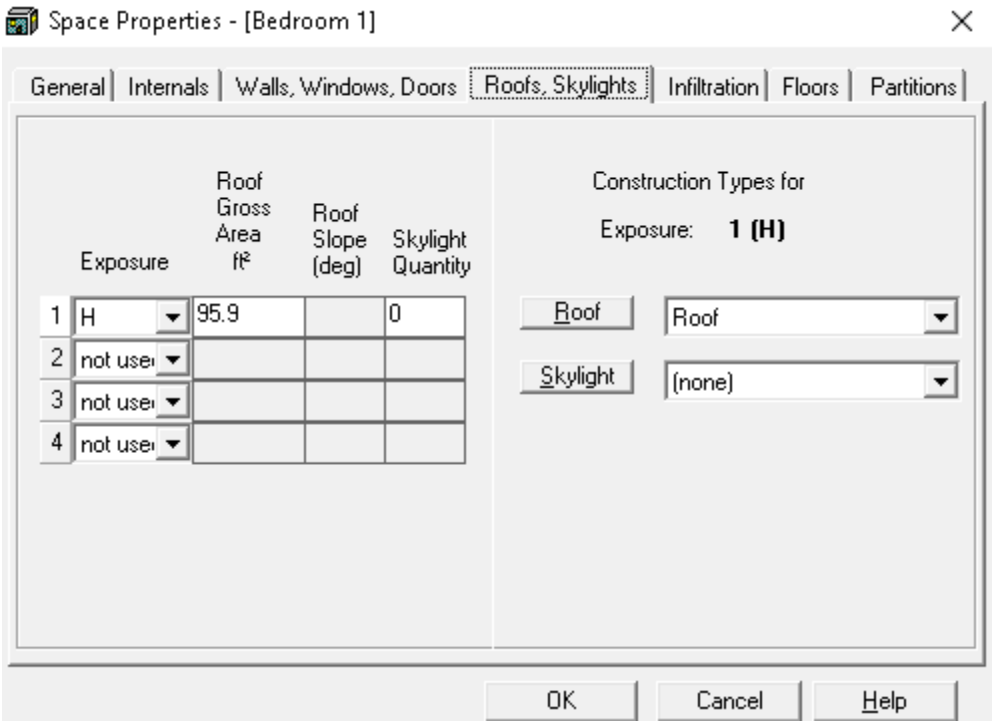
c. Sizing of Wall, Roof, Floor, and Partition

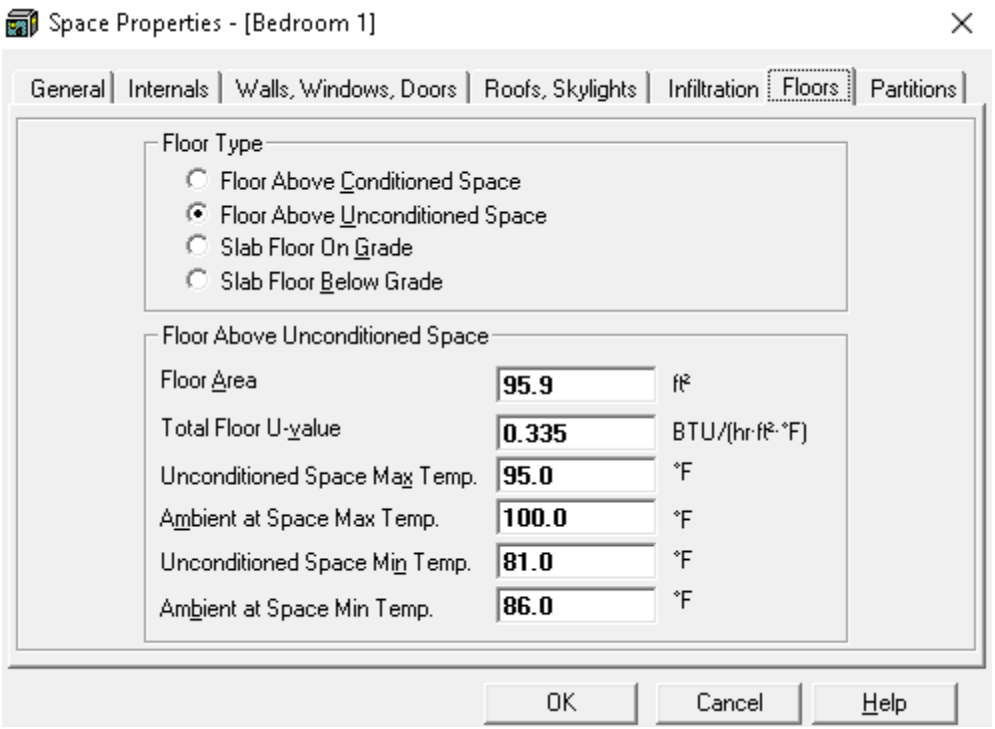
The calculations and details of the Floor Area, Wall Gross Area, Roof Gross Area, and Partition Area for all Spaces can be found in the Rooms/Spaces Data Table provided under the I. Construction Plan section

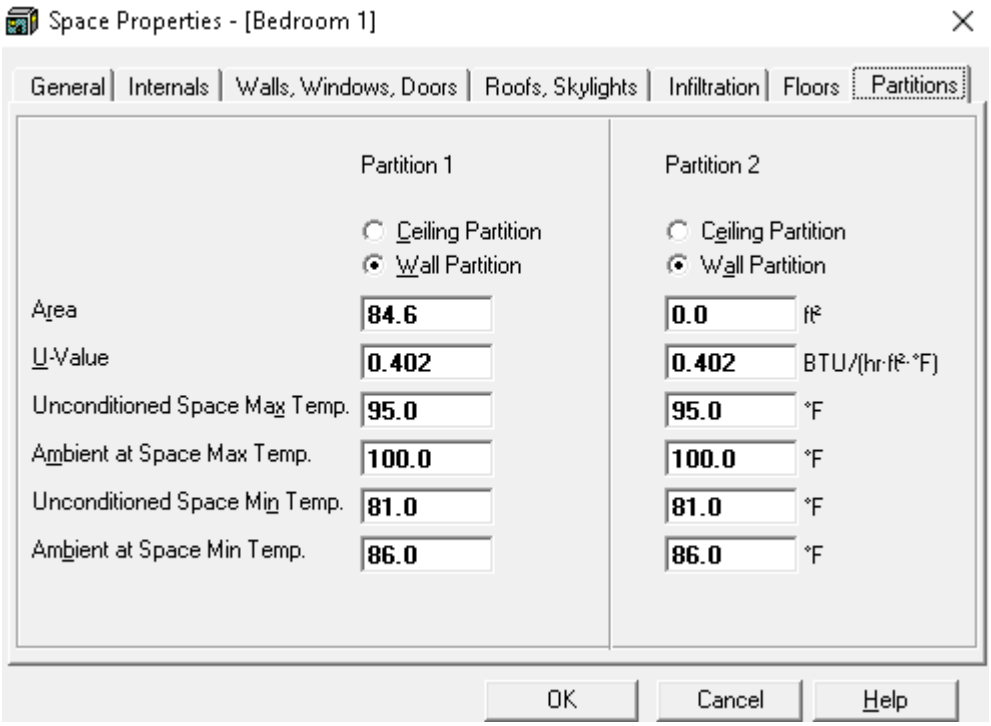
Bedroom 1


Space Properties - [Bedroom 1]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Bedroom 1
Floor Area
95.9
ft²
Avg Ceiling Height
8.8
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
HOTEL: Bedroom/living room
OA Requirement 1
5.0
CFM/person
OA Requirement 2
0.06
CFM/ft²
Space usage defaults: ASHRAE Std 62.1-2010
Defaults can be changed via View/Preferences.
OK
Cancel
Help

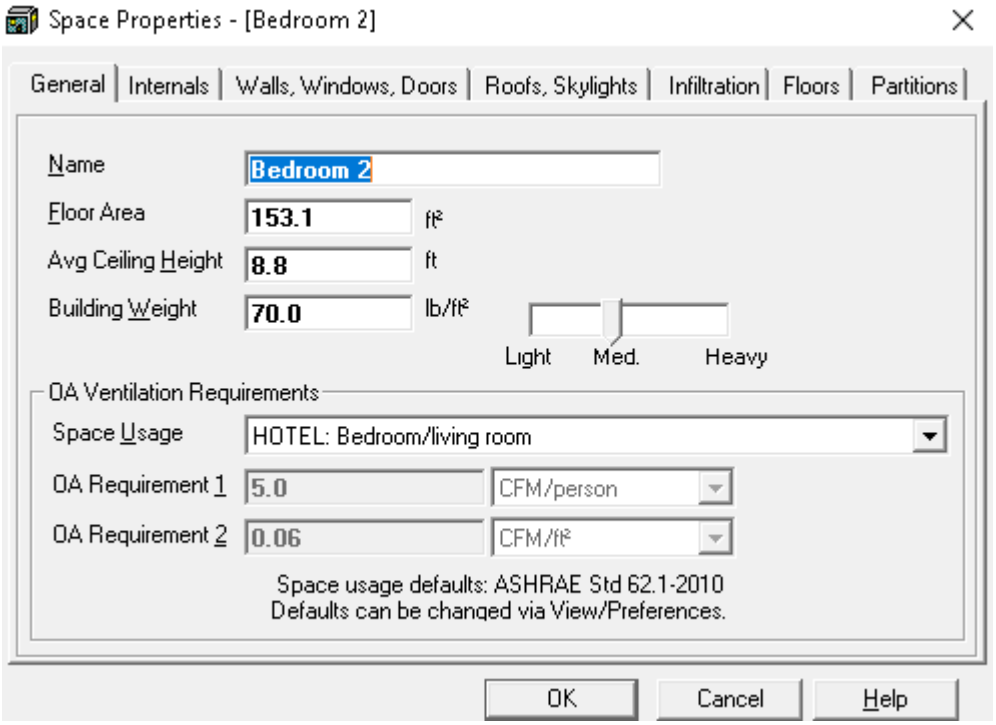

Space Properties - [Bedroom 1]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Wall Gross Area ft²
Window 1 Quantity
Window 2 Quantity
Door Quantity
1 SW 84.6 1 0 0
2 not use
3 not use
4 not use
5 not use
6 not use
7 not use
8 not use
Construction Types for Exposure: 1 (SW)
Wall
Wall
Window 1
BD1-Window (Without
Shade 1
(none)
Window 2
(none)
Shade 2
(none)
Door
(none)
OK
Cancel
Help

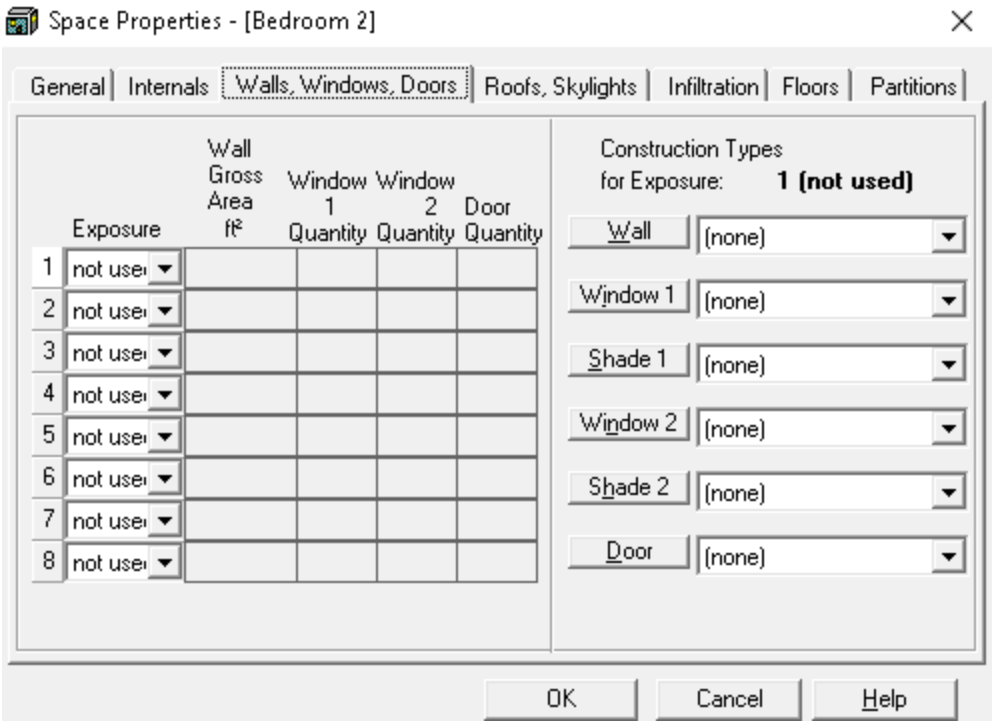

Space Properties - [Bedroom 1]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Roof Gross Area ft²
Roof Slope (deg)
Skylight Quantity
1 H 95.9 0
2 not use
3 not use
4 not use
Construction Types for
Exposure: 1 (H)
Roof
Roof
Skylight
(none)
OK
Cancel
Help

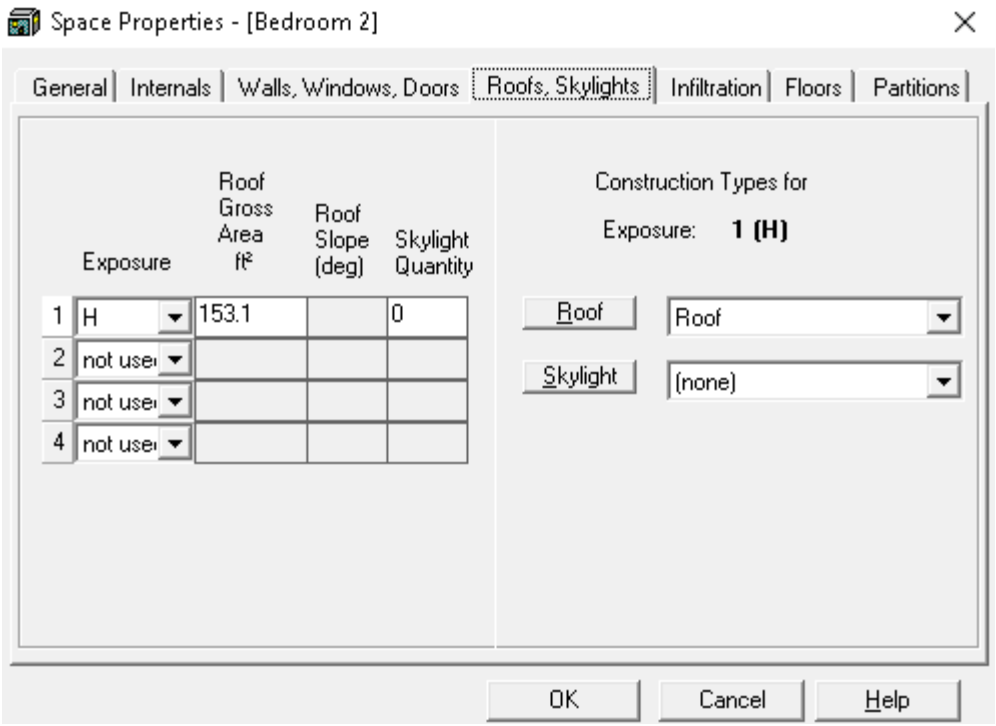

Space Properties - [Bedroom 1]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Floor Type
Floor Above Conditioned Space
Floor Above Unconditioned Space
Slab Floor On Grade
Slab Floor Below Grade
Floor Above Unconditioned Space
Floor Area 95.9 ft²
Total Floor U-value 0.335 BTU/(hr·ft²·°F)
Unconditioned Space Max Temp. 95.0 °F
Ambient at Space Max Temp. 100.0 °F
Unconditioned Space Min Temp. 81.0 °F
Ambient at Space Min Temp. 86.0 °F
OK
Cancel
Help

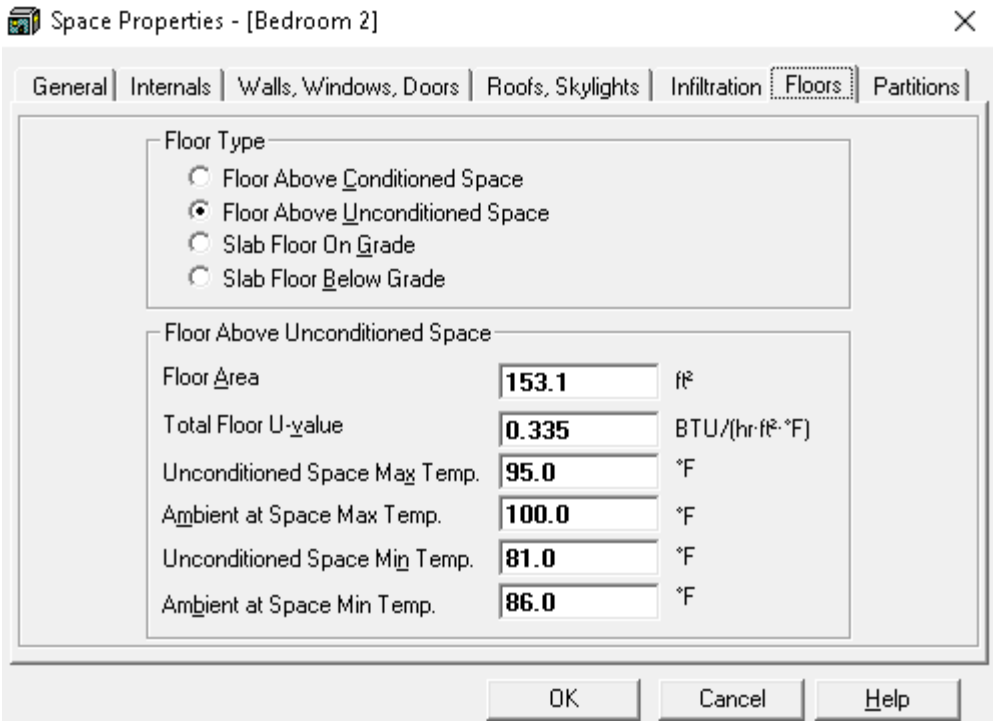

Space Properties - [Bedroom 1]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Partition 1
Partition 2
Ceiling Partition
Wall Partition
Ceiling Partition
Wall Partition
Area
84.6
0.0
ft²
U-Value
0.402
0.402
BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.
95.0
95.0
°F
Ambient at Space Max Temp.
100.0
100.0
°F
Unconditioned Space Min Temp.
81.0
81.0
°F
Ambient at Space Min Temp.
86.0
86.0
°F
OK
Cancel
Help

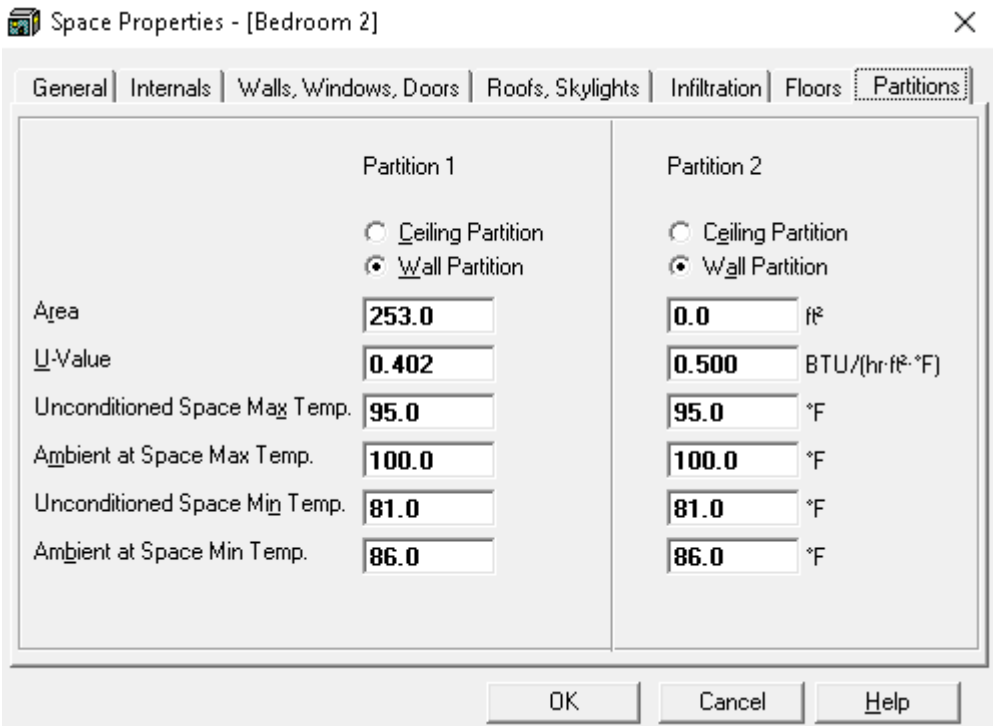
Bedroom 2


Space Properties - [Bedroom 2]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Bedroom 2
Floor Area
153.1
ft²
Avg Ceiling Height
8.8
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
HOTEL: Bedroom/living room
OA Requirement 1
5.0
CFM/person
OA Requirement 2
0.06
CFM/ft²
Space usage defaults: ASHRAE Std 62.1-2010
Defaults can be changed via View/Preferences.
OK
Cancel
Help

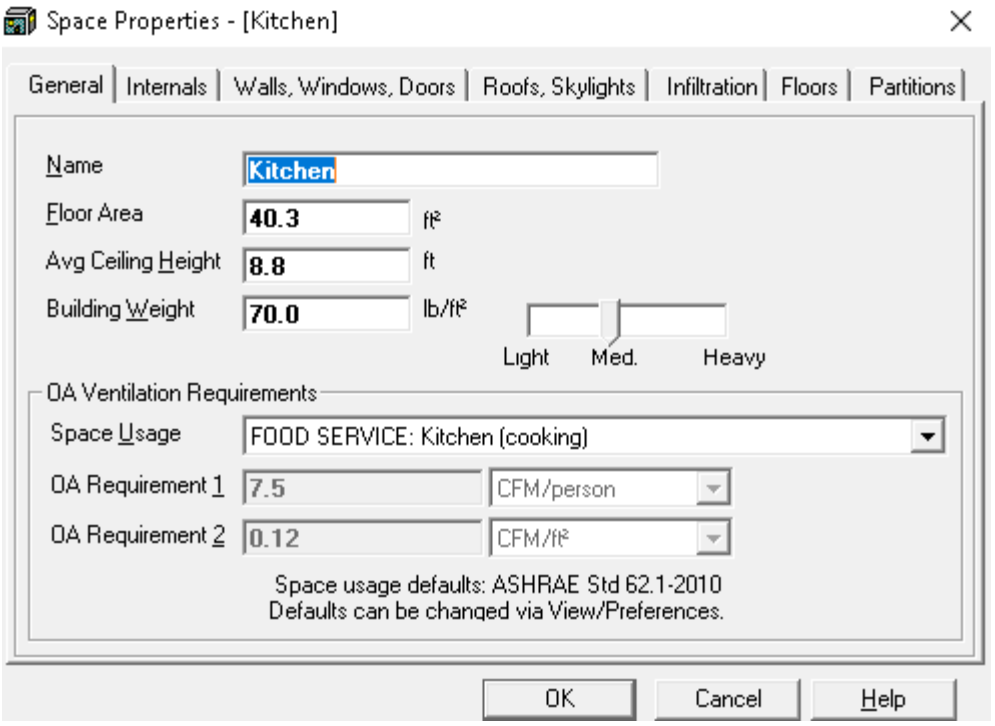

Space Properties - [Bedroom 2]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Wall Gross Area ft²
Window 1 Quantity
Window 2 Quantity
Door Quantity
1 not use
2 not use
3 not use
4 not use
5 not use
6 not use
7 not use
8 not use
Construction Types for Exposure: 1 (not used)
Wall
(none)
Window 1
(none)
Shade 1
(none)
Window 2
(none)
Shade 2
(none)
Door
(none)
OK
Cancel
Help

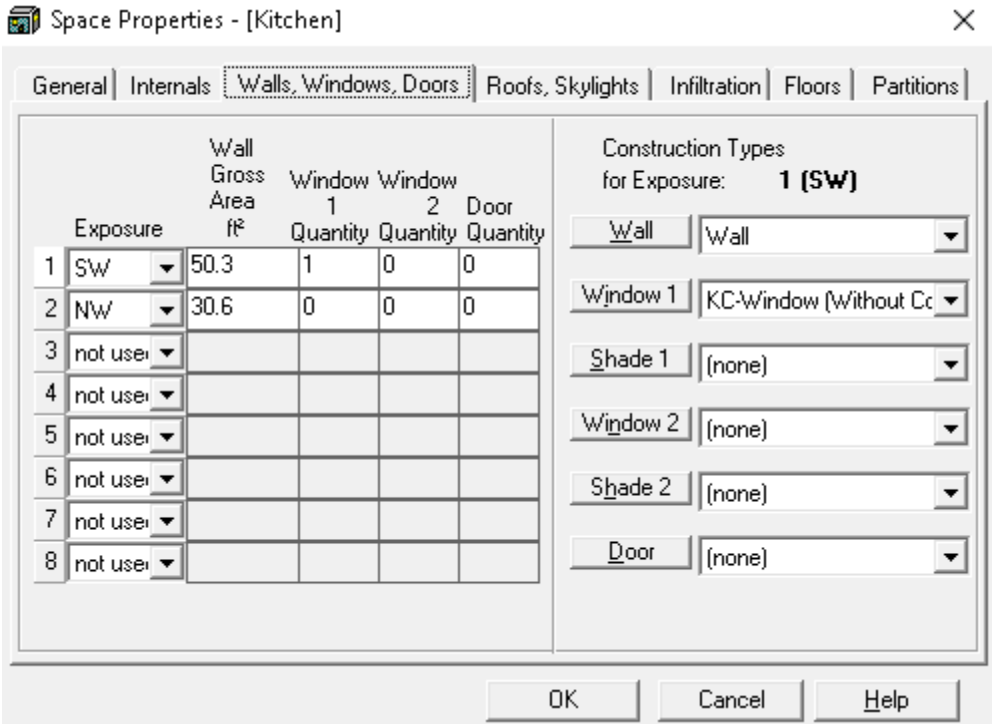

Space Properties - [Bedroom 2]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Roof Gross Area ft²
Roof Slope (deg)
Skylight Quantity
1 H 153.1 0
2 not use
3 not use
4 not use
Construction Types for Exposure: 1 (H)
Roof
Roof
Skylight
(none)
OK
Cancel
Help

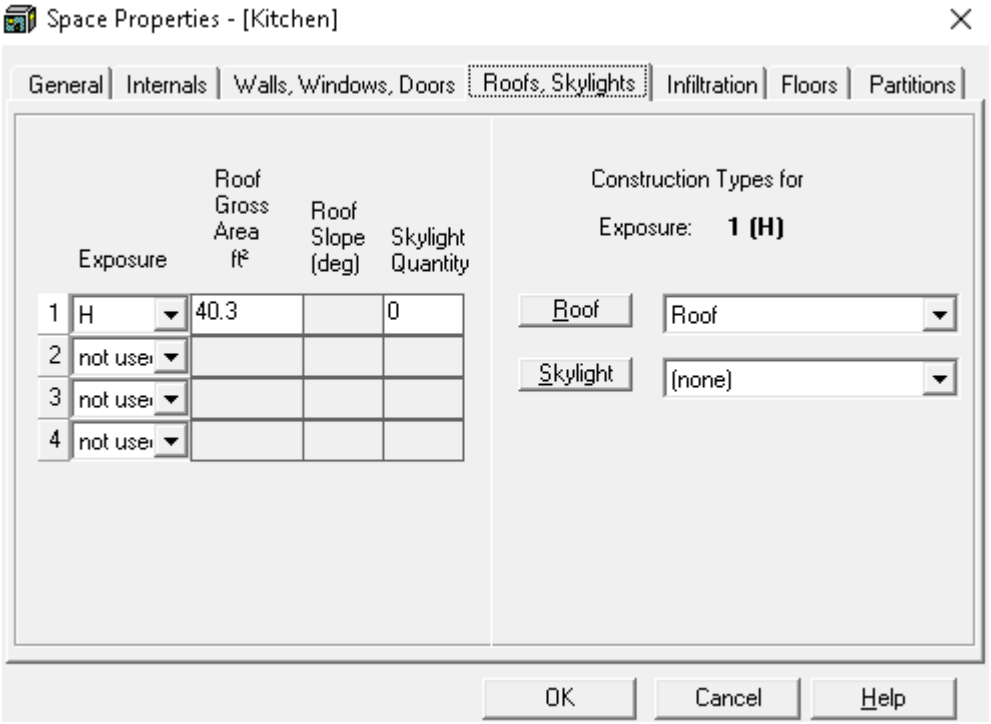

Space Properties - [Bedroom 2]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Floor Type
Floor Above Conditioned Space
Floor Above Unconditioned Space
Slab Floor On Grade
Slab Floor Below Grade
Floor Above Unconditioned Space
Floor Area
153.1
ft²
Total Floor U-value
0.335
BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.
95.0
°F
Ambient at Space Max Temp.
100.0
°F
Unconditioned Space Min Temp.
81.0
°F
Ambient at Space Min Temp.
86.0
°F
OK
Cancel
Help

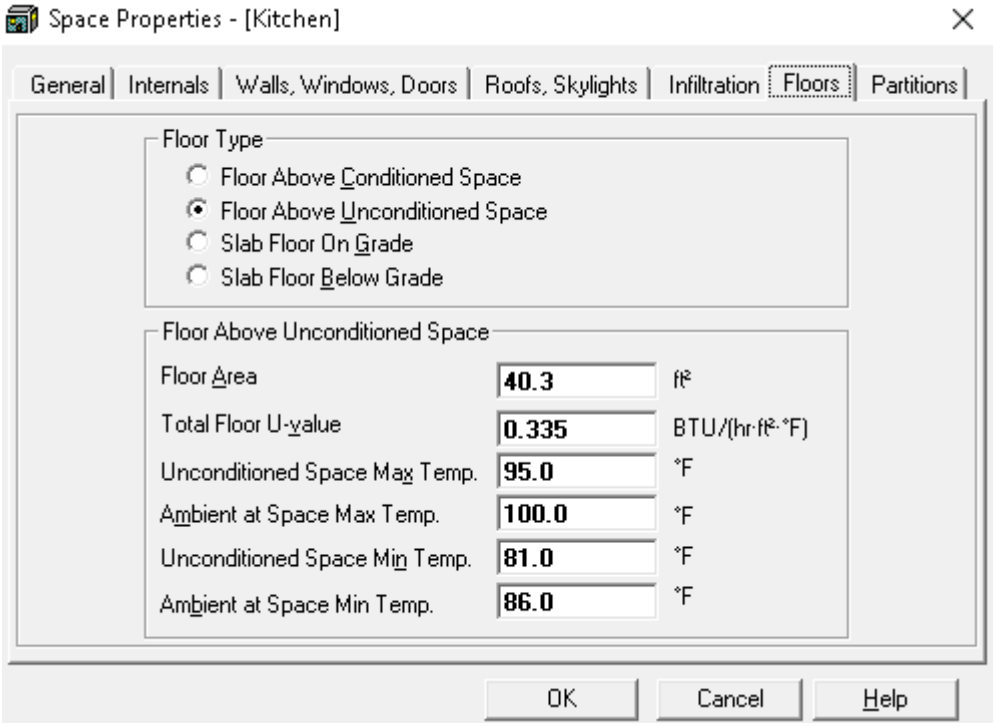

Space Properties - [Bedroom 2]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Partition 1
Partition 2
Ceiling Partition
Wall Partition
Ceiling Partition
Wall Partition
Area
253.0
0.0
ft²
U-Value
0.402
0.500
BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.
95.0
95.0
°F
Ambient at Space Max Temp.
100.0
100.0
°F
Unconditioned Space Min Temp.
81.0
81.0
°F
Ambient at Space Min Temp.
86.0
86.0
°F
OK
Cancel
Help

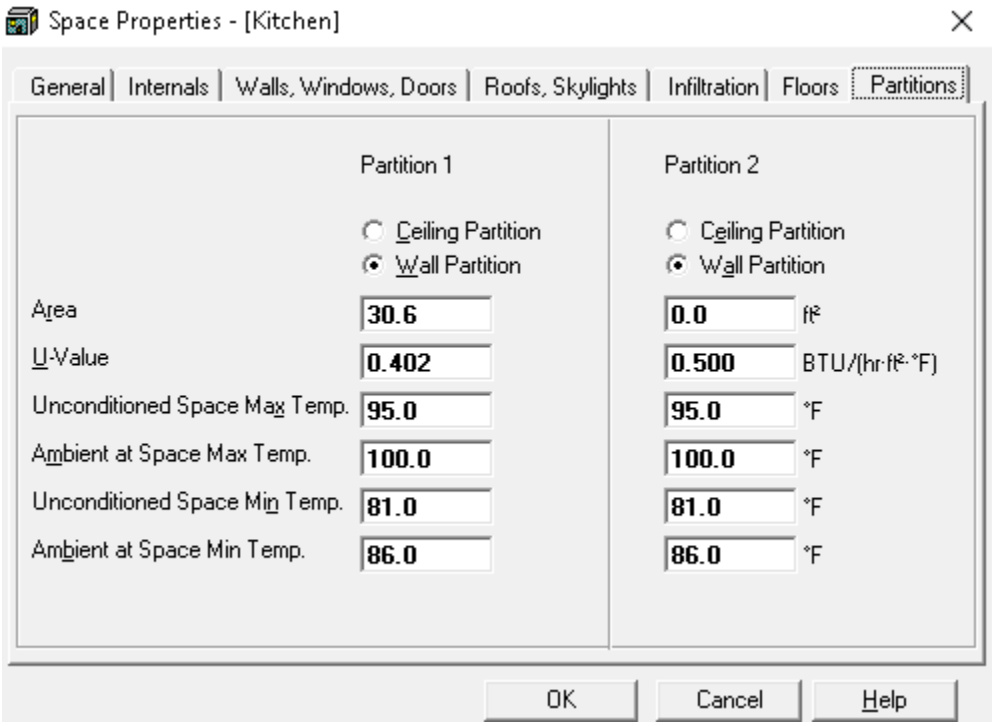
Kitchen


Space Properties - [Kitchen]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Kitchen
Floor Area
40.3
ft²
Avg Ceiling Height
8.8
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
FOOD SERVICE: Kitchen (cooking)
OA Requirement 1
7.5
CFM/person
OA Requirement 2
0.12
CFM/ft²
Space usage defaults: ASHRAE Std 62.1-2010
Defaults can be changed via View/Preferences.
OK
Cancel
Help

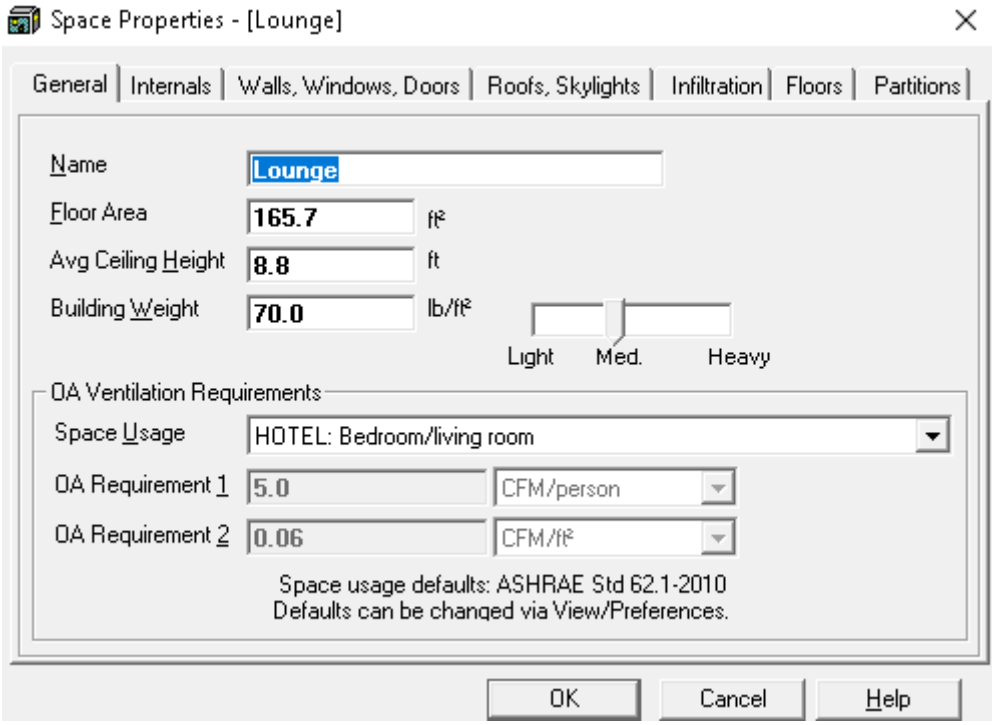

Space Properties - [Kitchen]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Wall Gross Area ft²
Window 1 Quantity
Window 2 Quantity
Door Quantity
1 SW 50.3 1 0 0
2 NW 30.6 0 0 0
3 not use
4 not use
5 not use
6 not use
7 not use
8 not use
Construction Types for Exposure: 1 (SW)
Wall
Wall
Window 1
KC-Window (Without Co
Shade 1
(none)
Window 2
(none)
Shade 2
(none)
Door
(none)
OK
Cancel
Help

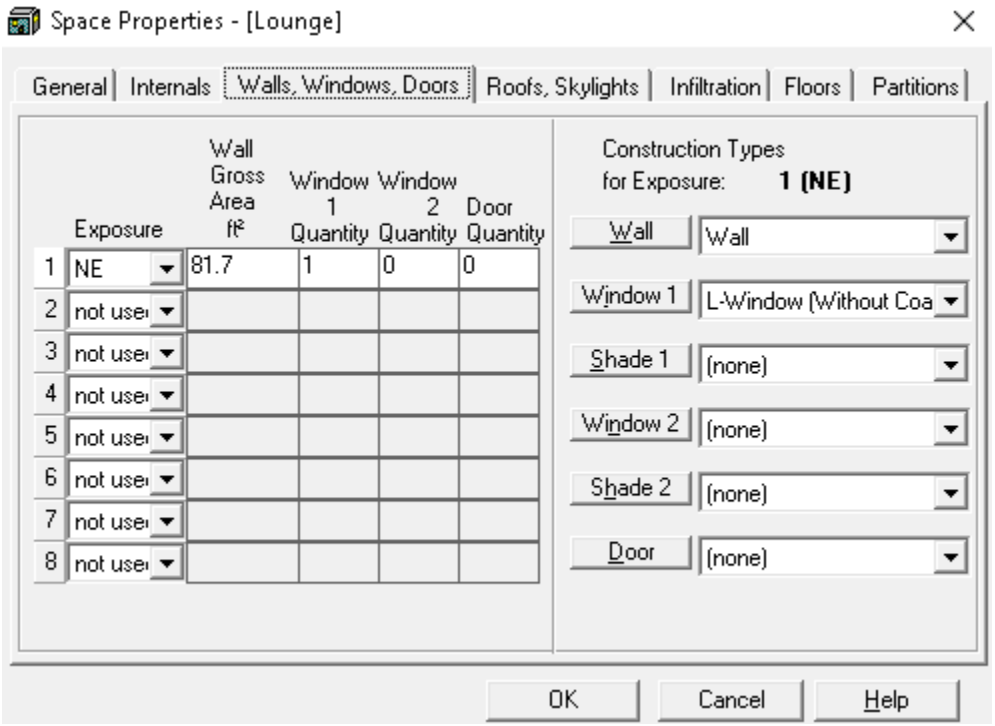

Space Properties - [Kitchen]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Roof Gross Area ft²
Roof Slope (deg)
Skylight Quantity
1 H 40.3 0
2 not use
3 not use
4 not use
Construction Types for
Exposure: 1 (H)
Roof
Roof
Skylight
(none)
OK
Cancel
Help

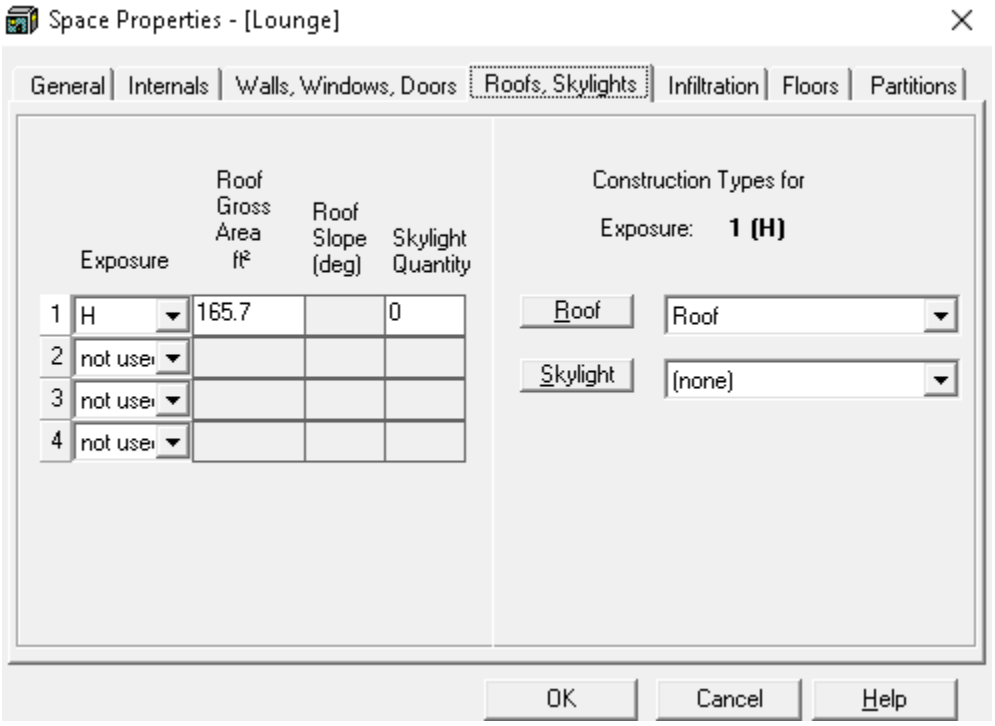

Space Properties - [Kitchen]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Floor Type
Floor Above Conditioned Space
Floor Above Unconditioned Space
Slab Floor On Grade
Slab Floor Below Grade
Floor Above Unconditioned Space
Floor Area 40.3 ft²
Total Floor U-value 0.335 BTU/(hr·ft²·°F)
Unconditioned Space Max Temp. 95.0 °F
Ambient at Space Max Temp. 100.0 °F
Unconditioned Space Min Temp. 81.0 °F
Ambient at Space Min Temp. 86.0 °F
OK
Cancel
Help

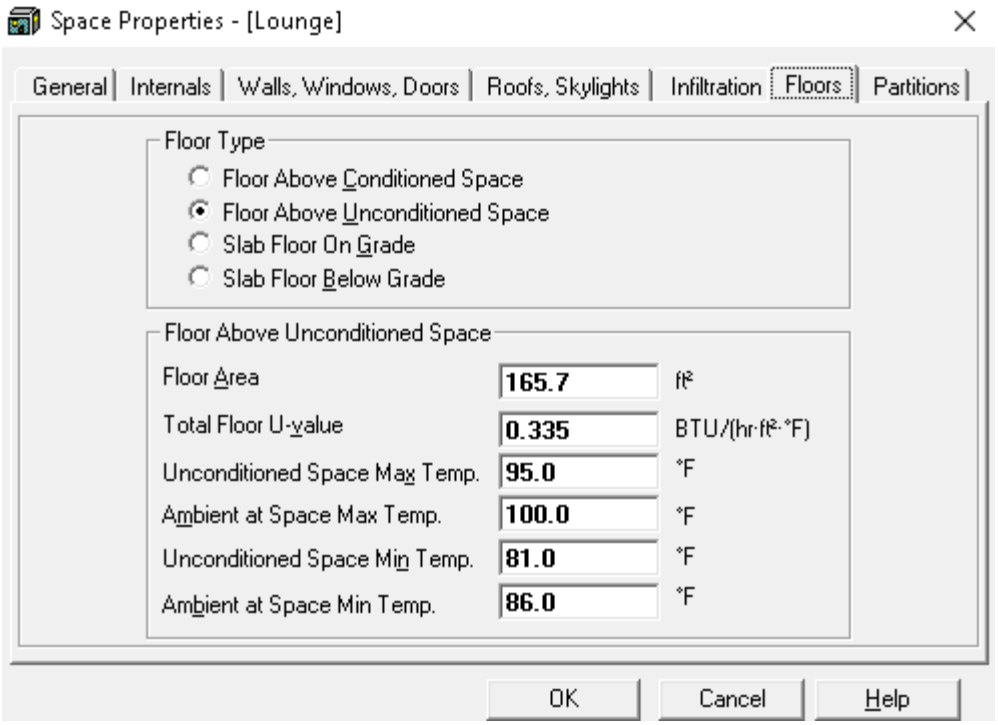

Space Properties - [Kitchen]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Partition 1
Partition 2
Ceiling Partition
Wall Partition
Ceiling Partition
Wall Partition
Area
30.6
0.0
ft²
U-Value
0.402
0.500
BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.
95.0
95.0
°F
Ambient at Space Max Temp.
100.0
100.0
°F
Unconditioned Space Min Temp.
81.0
81.0
°F
Ambient at Space Min Temp.
86.0
86.0
°F
OK
Cancel
Help

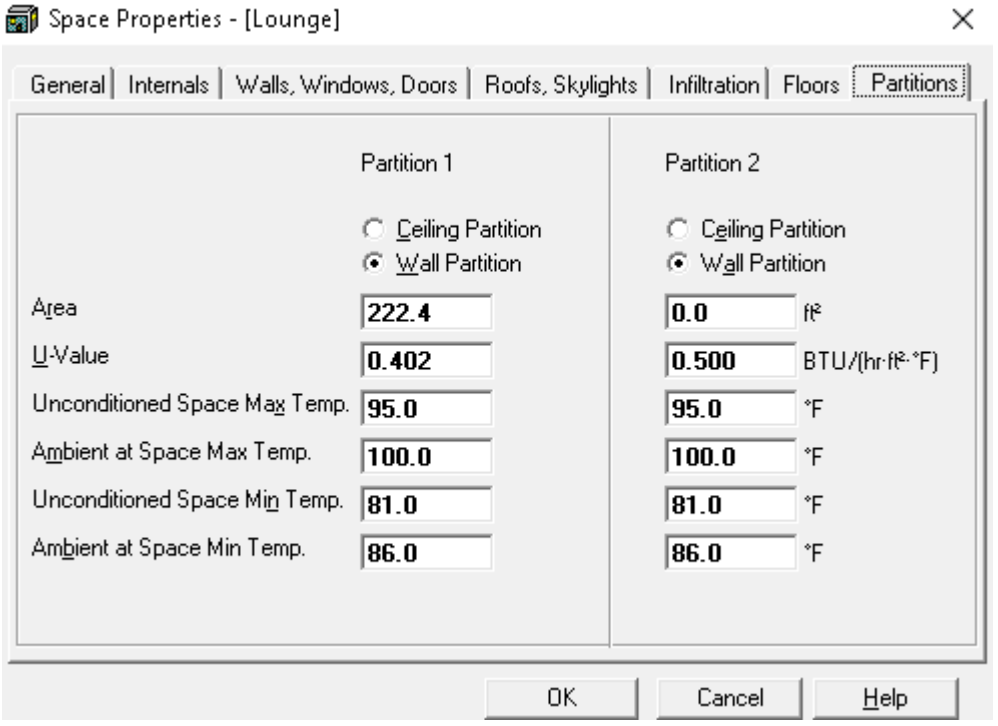
Lounge


Space Properties - [Lounge]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Lounge
Floor Area
165.7
ft²
Avg Ceiling Height
8.8
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
HOTEL: Bedroom/living room
OA Requirement 1
5.0
CFM/person
OA Requirement 2
0.06
CFM/ft²
Space usage defaults: ASHRAE Std 62.1-2010
Defaults can be changed via View/Preferences.
OK
Cancel
Help


Space Properties - [Lounge]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Wall Gross Area ft²
Window 1 Quantity
Window 2 Quantity
Door Quantity
1 NE 81.7 1 0 0
2 not use
3 not use
4 not use
5 not use
6 not use
7 not use
8 not use
Construction Types for Exposure: 1 (NE)
Wall
Wall
Window 1
L-Window (Without Coa
Shade 1
(none)
Window 2
(none)
Shade 2
(none)
Door
(none)
OK
Cancel
Help

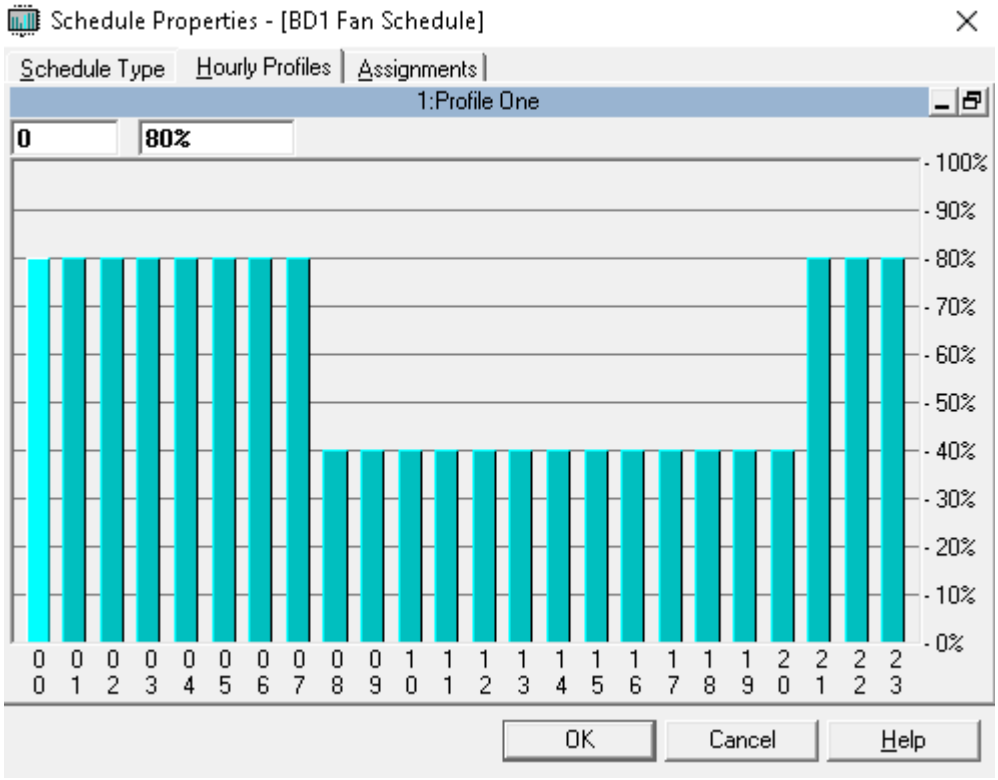

Space Properties - [Lounge]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Exposure
Roof Gross Area ft²
Roof Slope (deg)
Skylight Quantity
1 H 165.7 0
2 not use
3 not use
4 not use
Construction Types for Exposure: 1 (H)
Roof
Roof
Skylight
(none)
OK
Cancel
Help

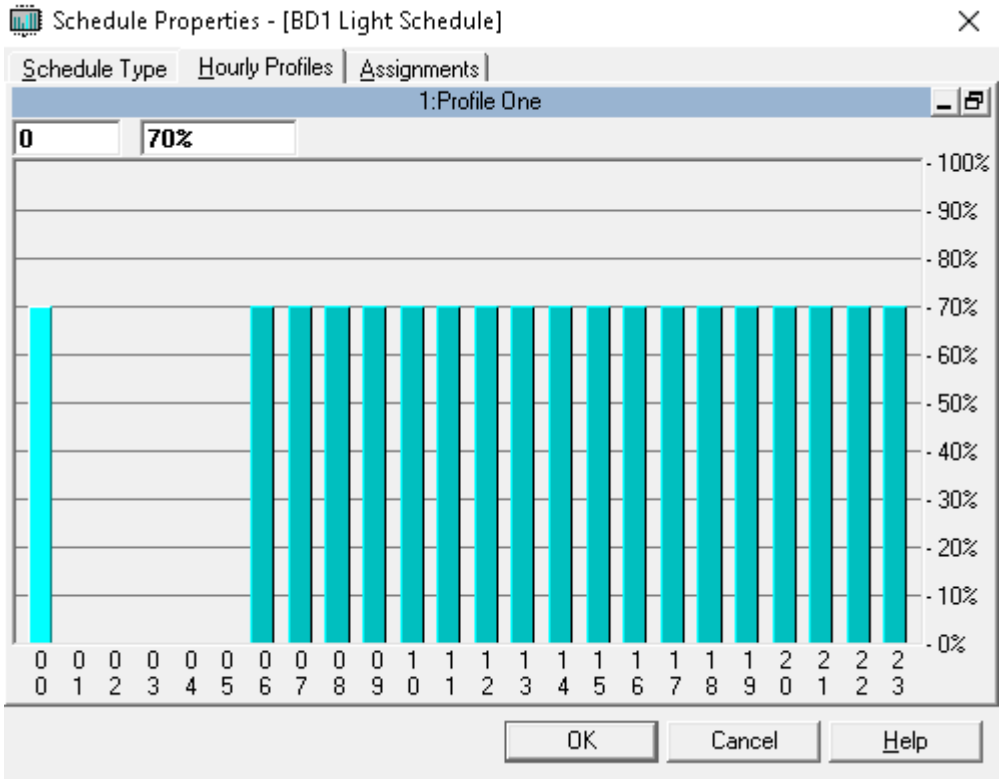

Space Properties - [Lounge]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Floor Type
Floor Above Conditioned Space
Floor Above Unconditioned Space
Slab Floor On Grade
Slab Floor Below Grade
Floor Above Unconditioned Space
Floor Area
165.7
ft²
Total Floor U-value
0.335
BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.
95.0
°F
Ambient at Space Max Temp.
100.0
°F
Unconditioned Space Min Temp.
81.0
°F
Ambient at Space Min Temp.
86.0
°F
OK
Cancel
Help

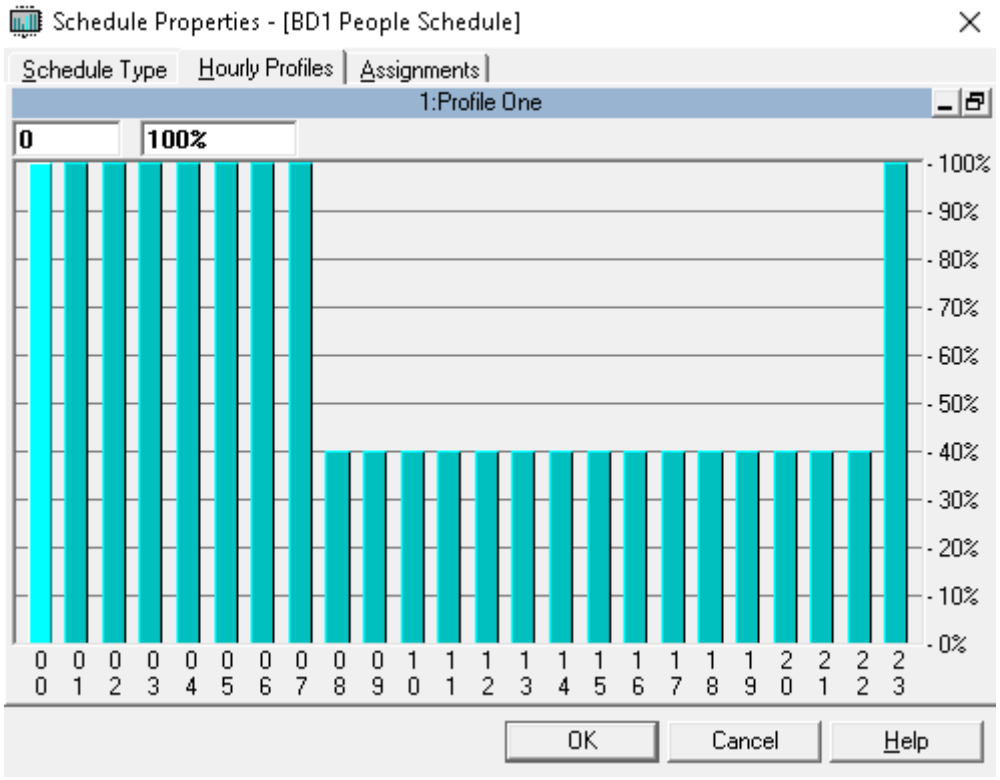

Space Properties - [Lounge]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Partition 1
Partition 2
Ceiling Partition
Wall Partition
Ceiling Partition
Wall Partition
Area
222.4
0.0
ft²
U-Value
0.402
0.500
BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.
95.0
95.0
°F
Ambient at Space Max Temp.
100.0
100.0
°F
Unconditioned Space Min Temp.
81.0
81.0
°F
Ambient at Space Min Temp.
86.0
86.0
°F
OK
Cancel
Help

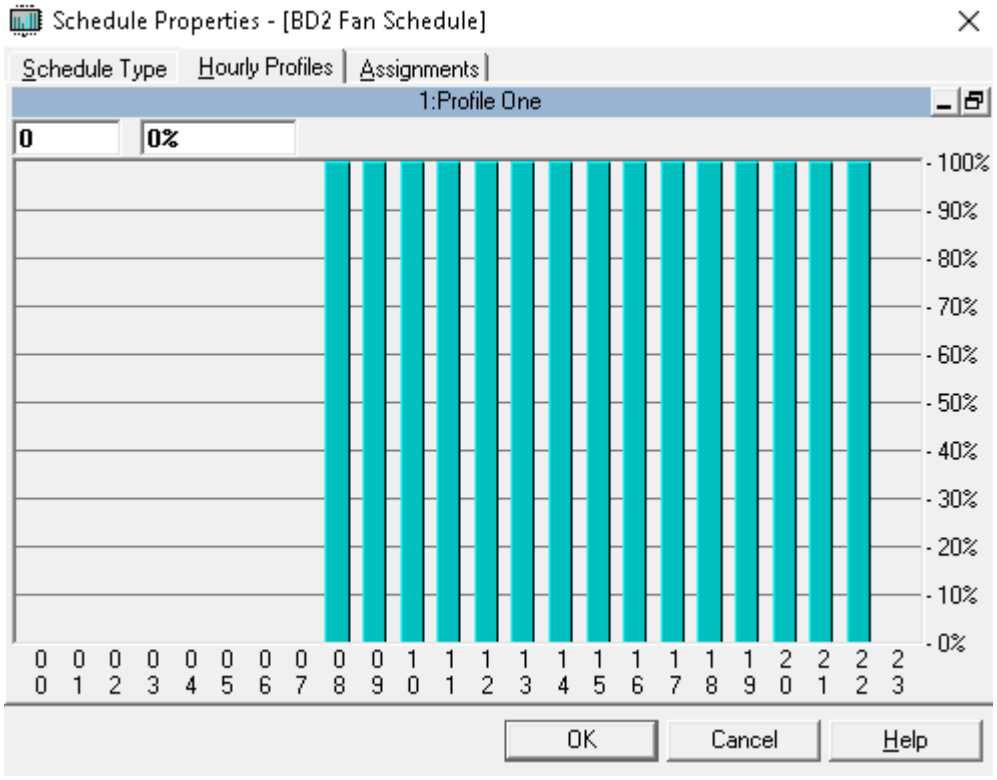
Schedules

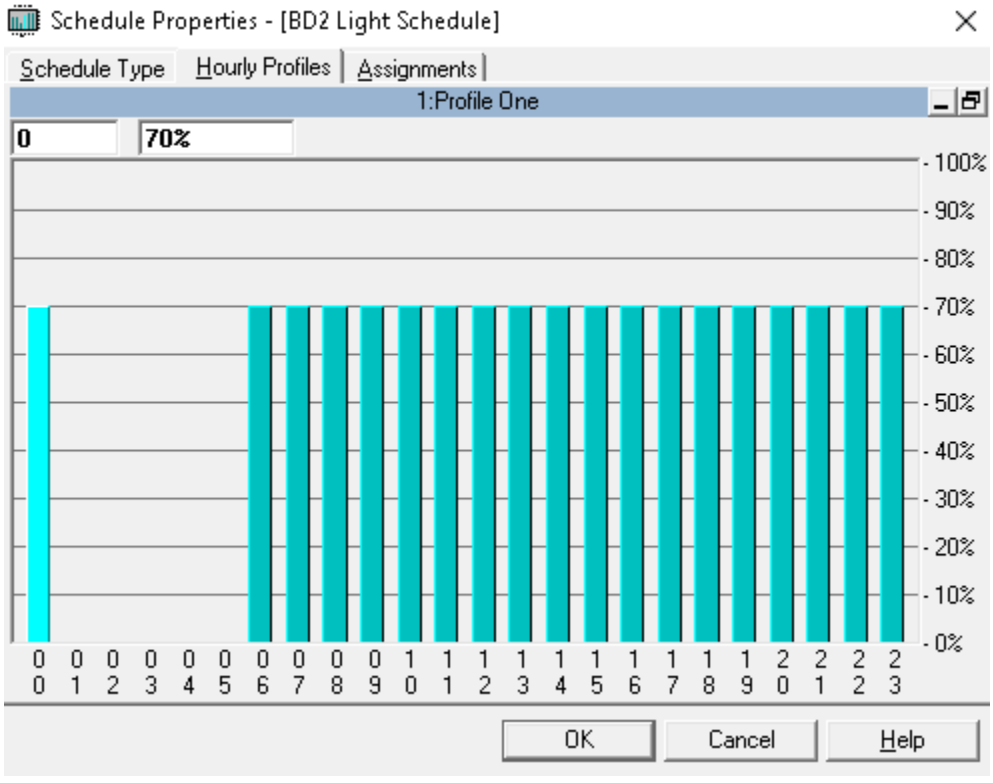
Schedule	Schedule Type
<New default Schedule>	
BD1 Fan Schedule	Fractional
BD1 Light Schedule	Fractional
BD1 People Schedule	Fractional
BD2 Fan Schedule	Fractional
BD2 Light Schedule	Fractional
BD2 People Schedule	Fractional
Fan/Thermostat Schedule	Fan & Thermostat
Kitchen Light Schedule	Fractional
Kitchen People Schedule	Fractional
Lounge Fan Schedule	Fractional
Lounge Light Schedule	Fractional
Lounge People Schedule	Fractional

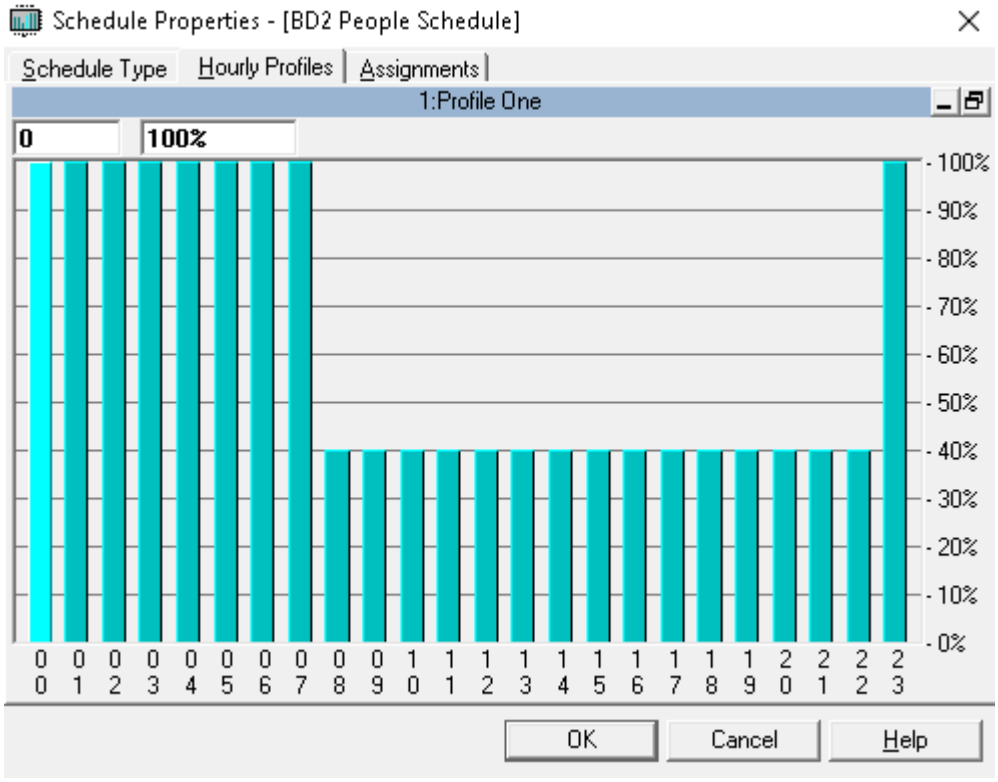


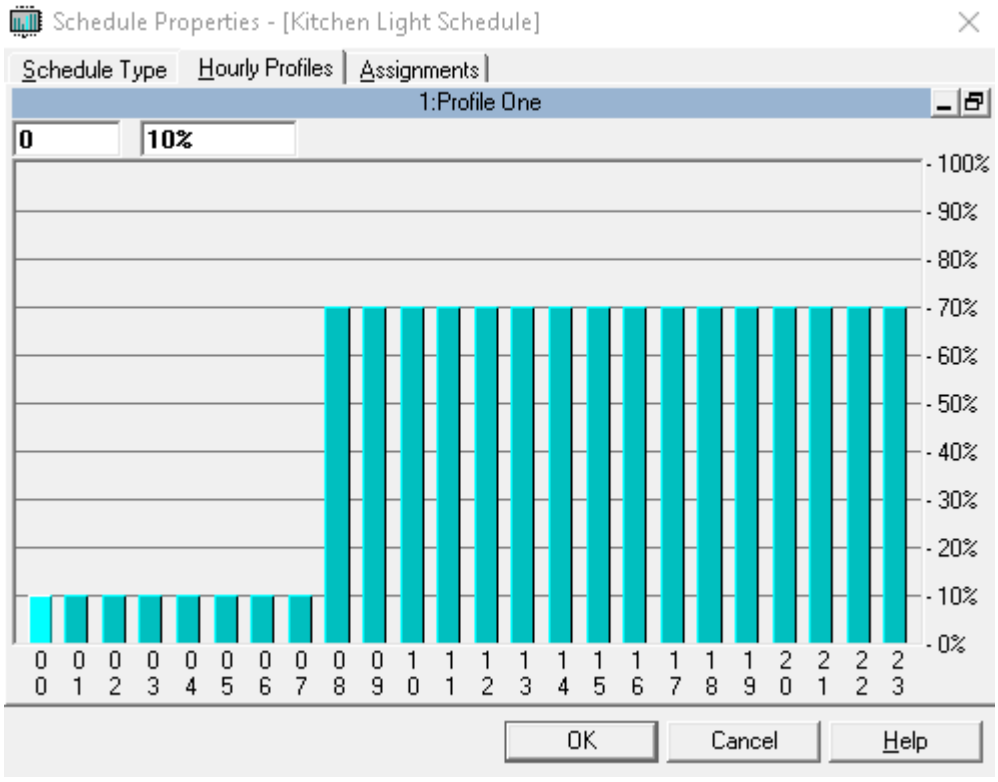

Schedule Properties - [BD1 Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
70%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

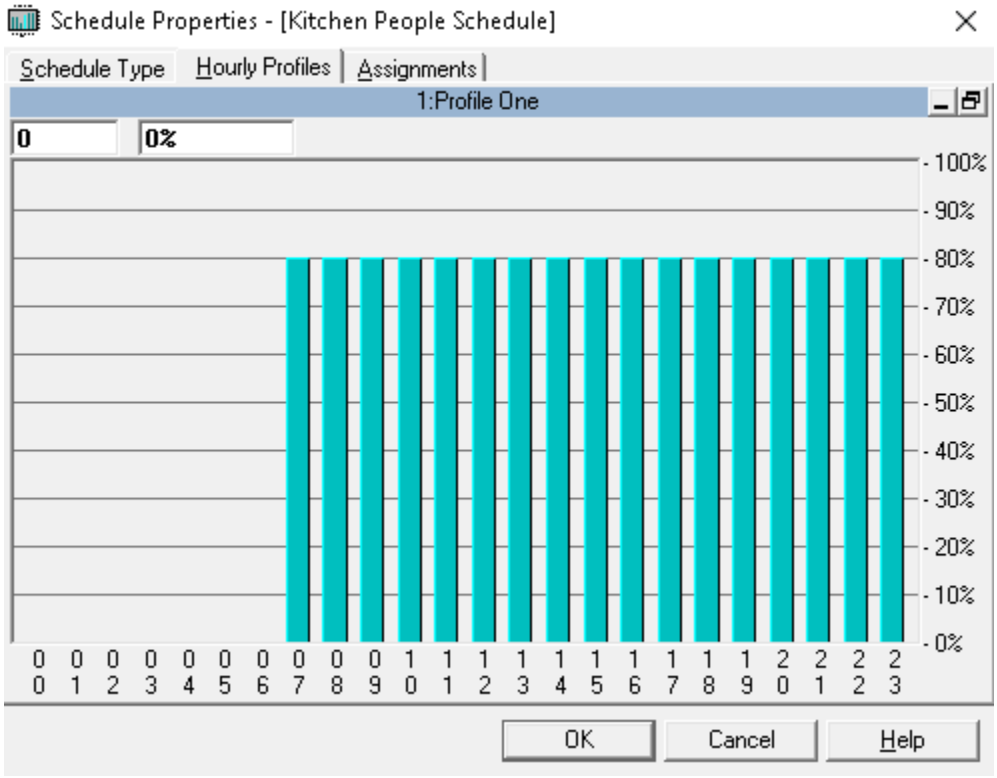

Schedule Properties - [BD1 People Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
100%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

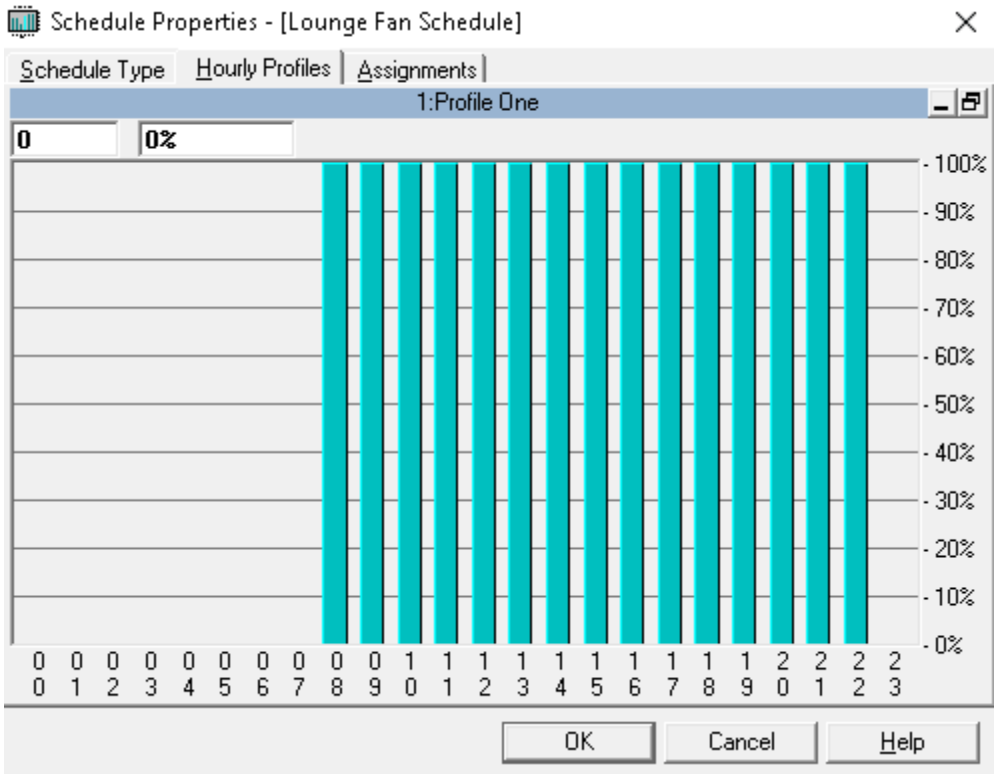

Schedule Properties - [BD2 Fan Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
0%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

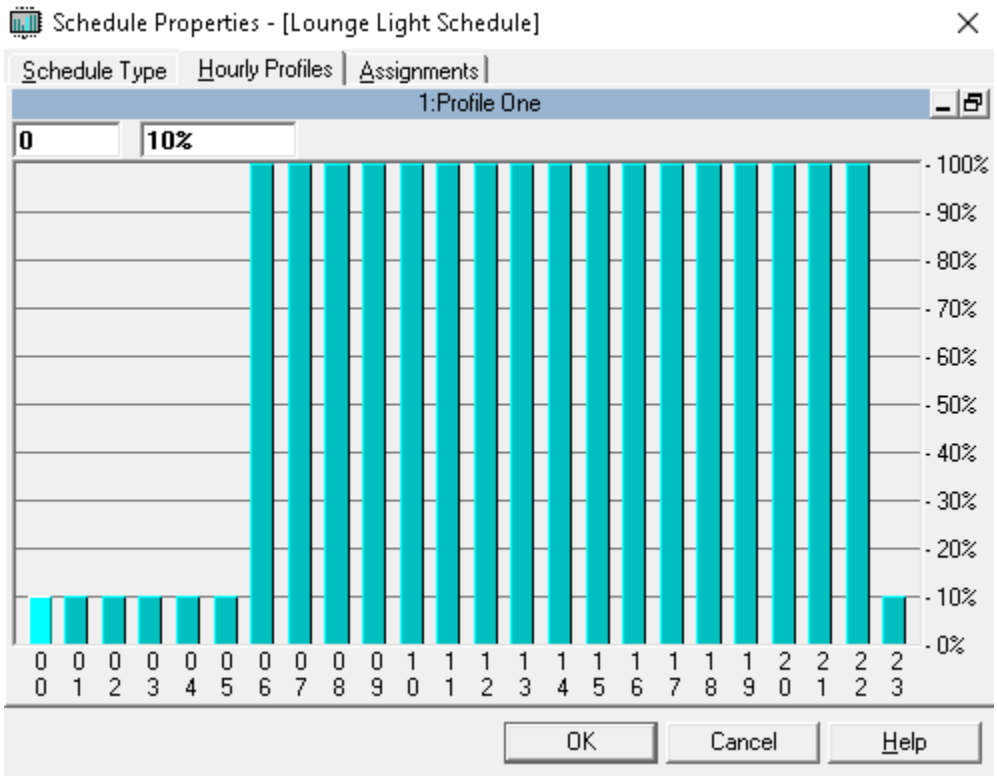

Schedule Properties - [BD2 Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
70%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

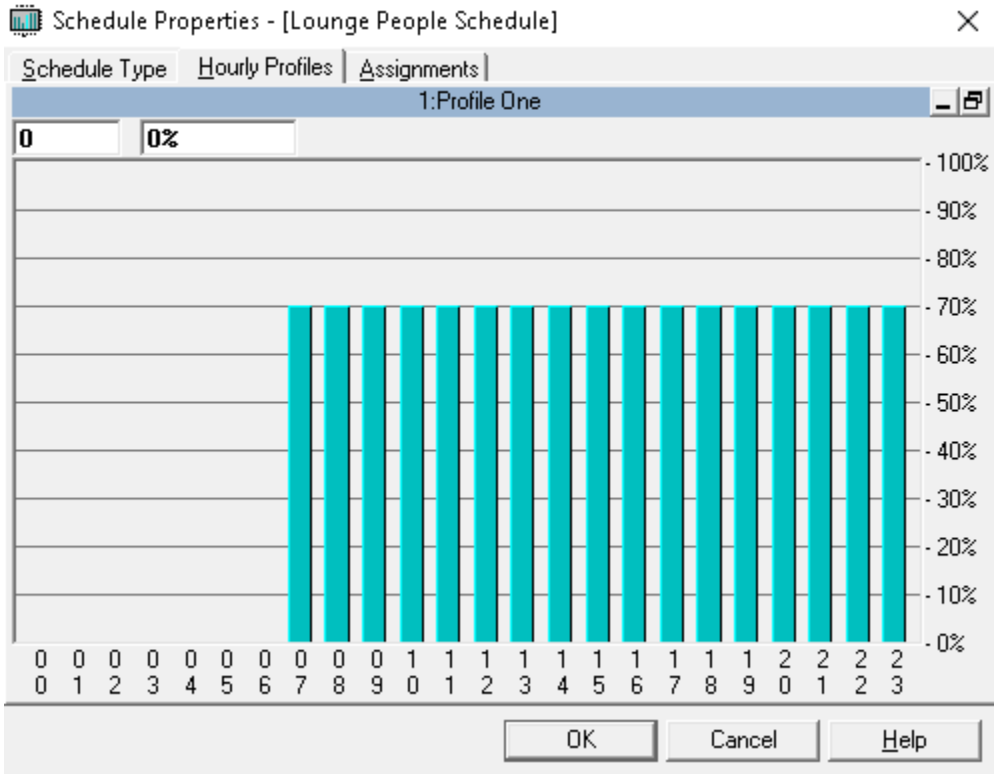

Schedule Properties - [BD2 People Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
100%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Schedule Properties - [Kitchen Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Schedule Properties - [Kitchen People Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
0%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

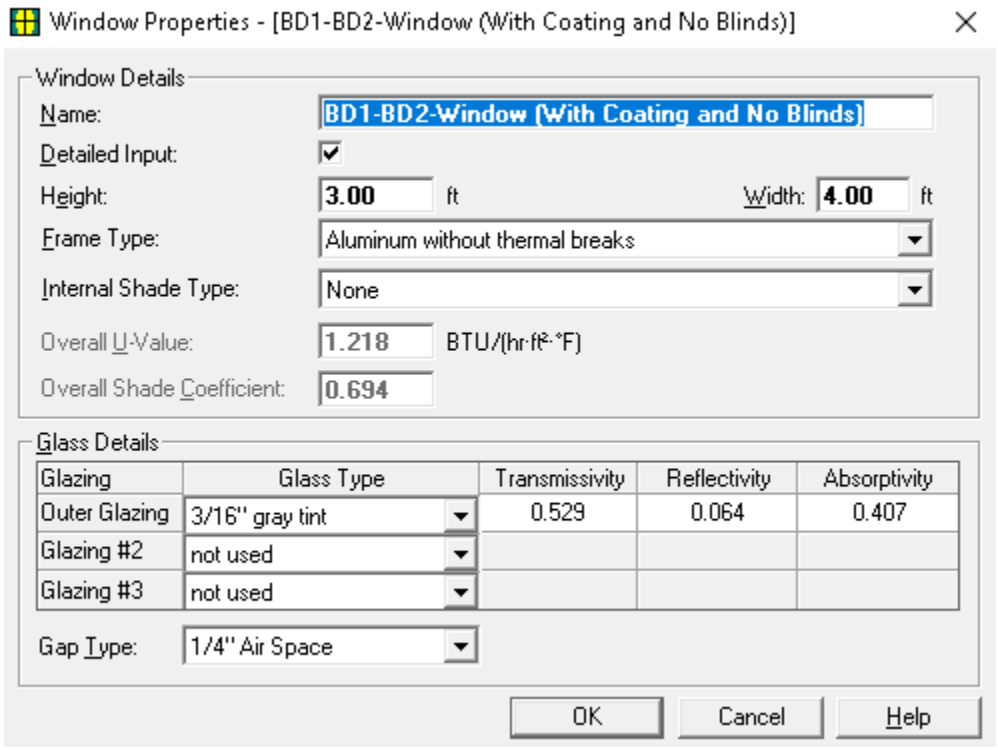

Schedule Properties - [Lounge Fan Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
0%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

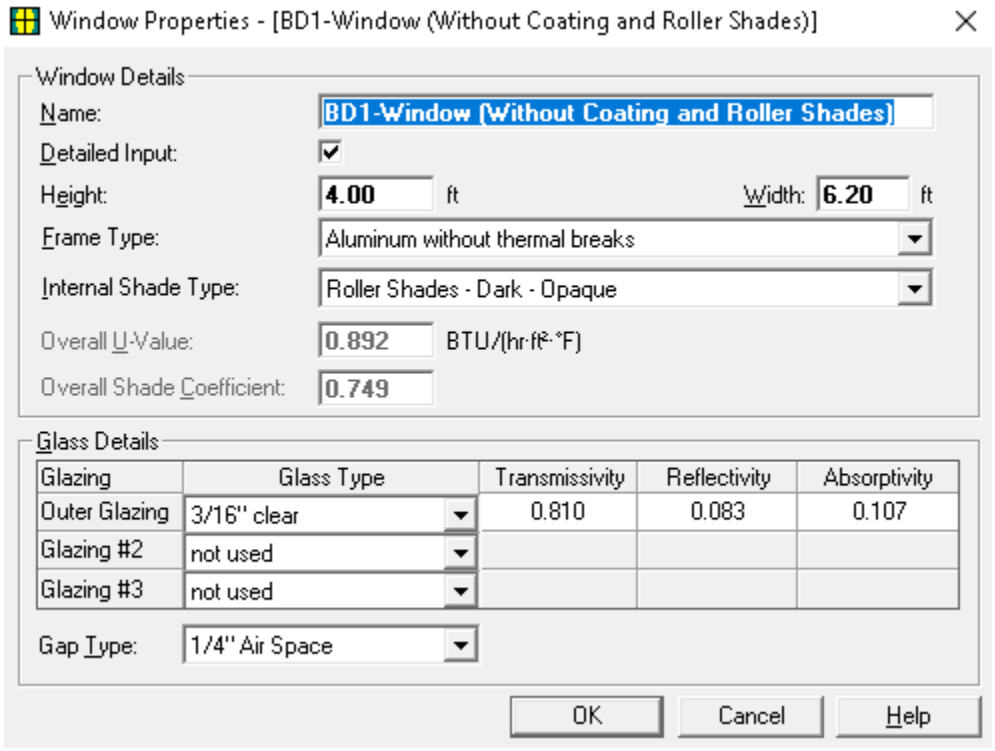

Schedule Properties - [Lounge Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

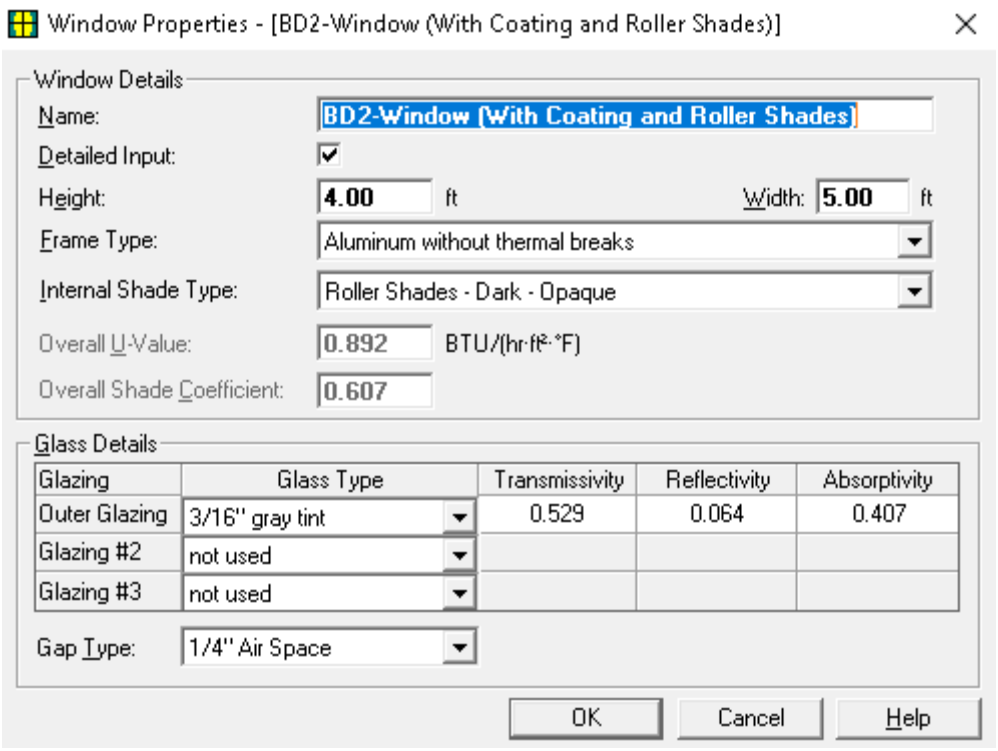

Schedule Properties - [Lounge People Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
0%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

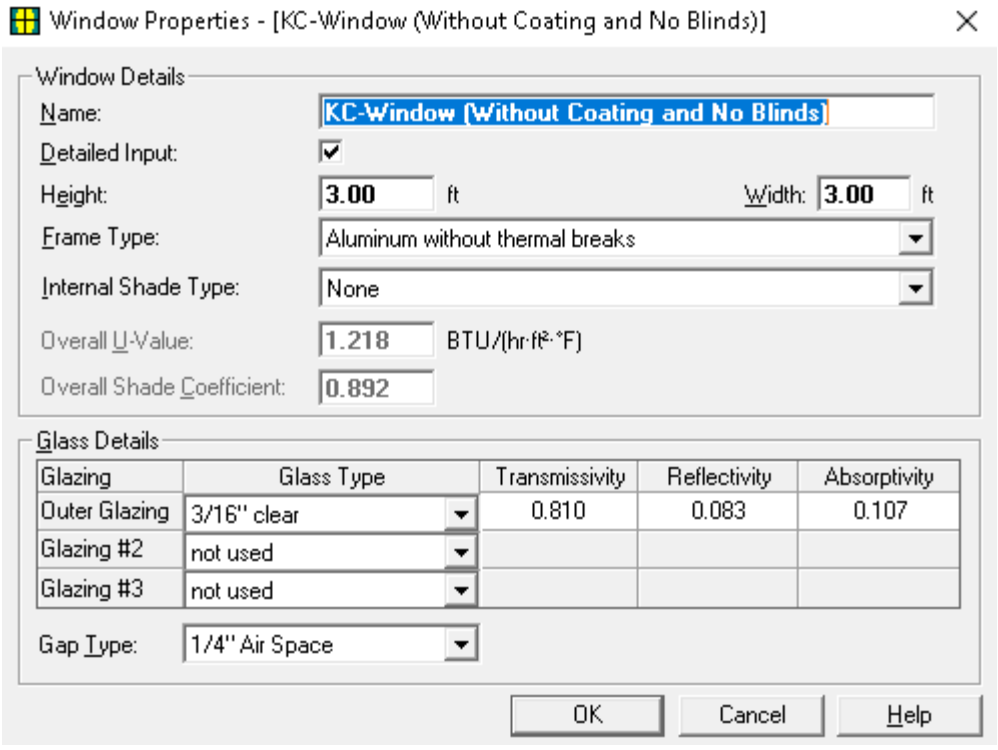
d. Sizing of Window

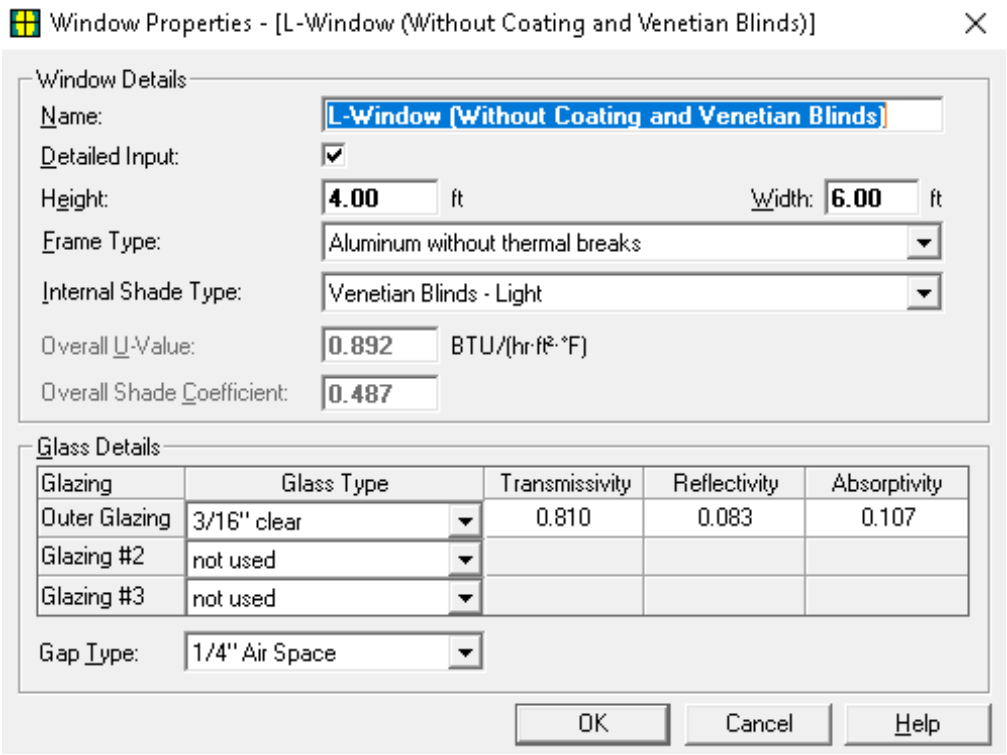
The details of the Window Height and Width can be found in the Apartment Technical Drawing and the Vertical Dimensions Data Table provided under the I. Construction Plan section






Window Properties - [BD2-Window (With Coating and Roller Shades)]
Window Details
Name: BD2-Window (With Coating and Roller Shades)
Detailed Input:
Height: 4.00 ft
Width: 5.00 ft
Frame Type: Aluminum without thermal breaks
Internal Shade Type: Roller Shades - Dark - Opaque
Overall U-Value: 0.892 BTU/(hr·ft²·°F)
Overall Shade Coefficient: 0.607
Glass Details
Glazing | Glass Type | Transmissivity | Reflectivity | Absorptivity
Outer Glazing | 3/16" gray tint | 0.529 | 0.064 | 0.407
Glazing #2 | not used
Glazing #3 | not used
Gap Type: 1/4" Air Space
OK
Cancel
Help


Window Properties - [KC-Window (Without Coating and No Blinds)]
Window Details
Name: KC-Window (Without Coating and No Blinds)
Detailed Input:
Height: 3.00 ft
Width: 3.00 ft
Frame Type: Aluminum without thermal breaks
Internal Shade Type: None
Overall U-Value: 1.218 BTU/(hr·ft²·°F)
Overall Shade Coefficient: 0.892
Glass Details
Glazing | Glass Type | Transmissivity | Reflectivity | Absorptivity
Outer Glazing | 3/16" clear | 0.810 | 0.083 | 0.107
Glazing #2 | not used
Glazing #3 | not used
Gap Type: 1/4" Air Space
OK
Cancel
Help

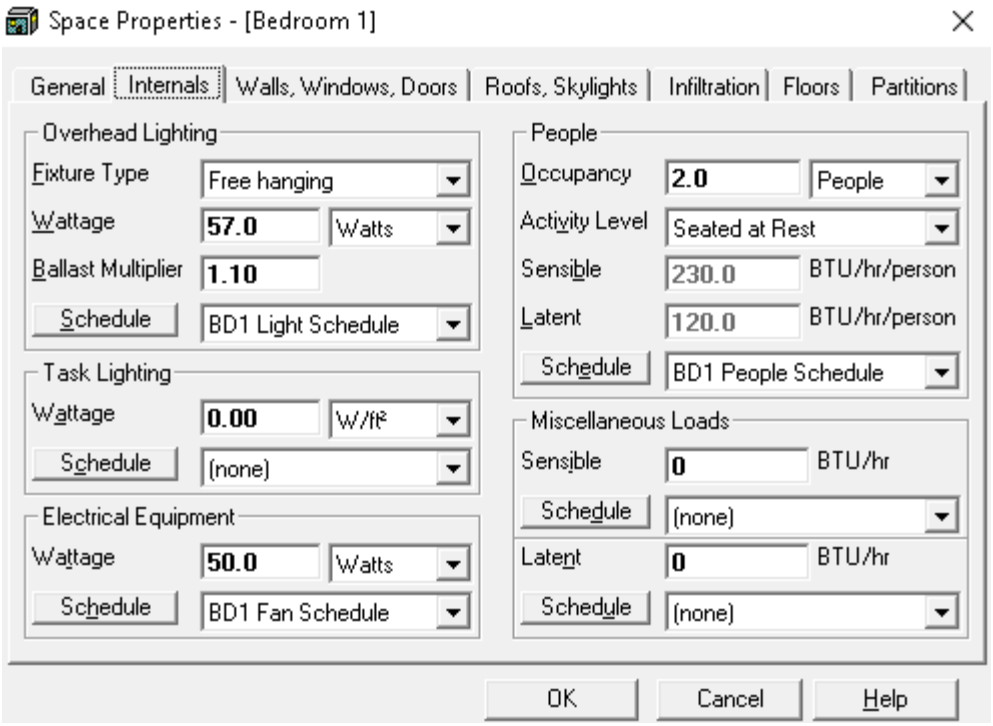


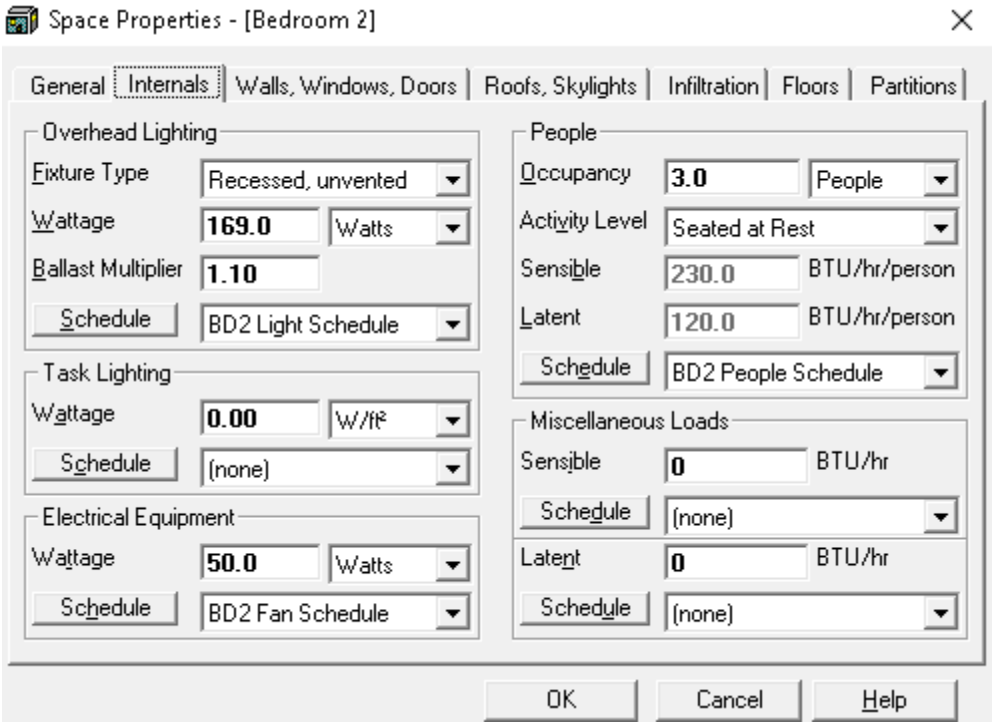
e. Sizing of Door

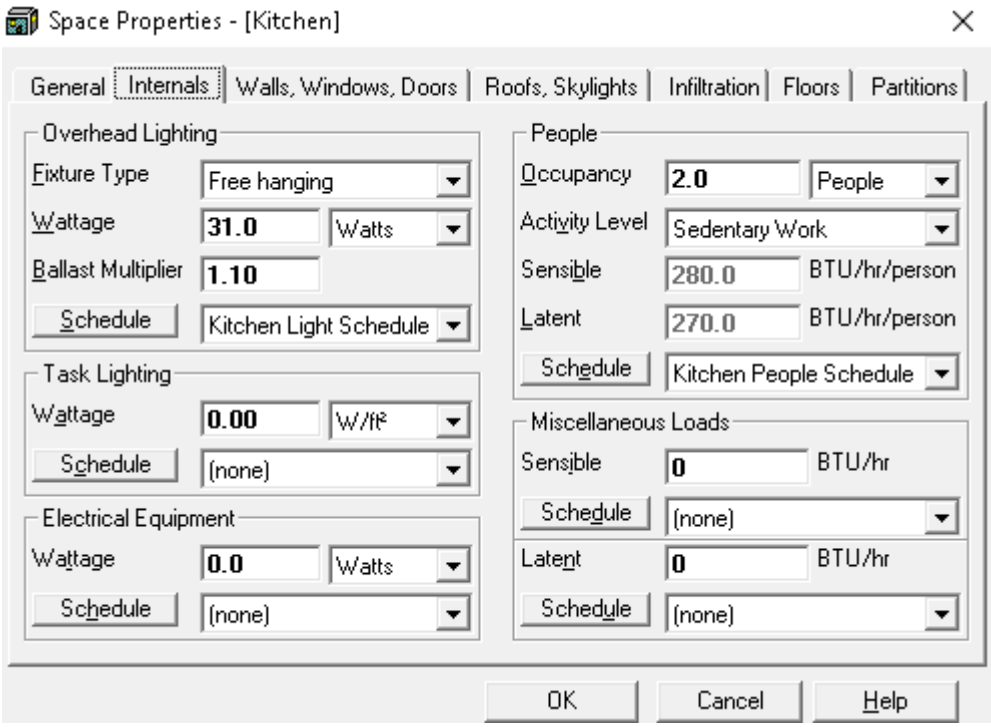
During the analysis, it was concluded that no doors were necessary, resulting in no sizing requirements for doors

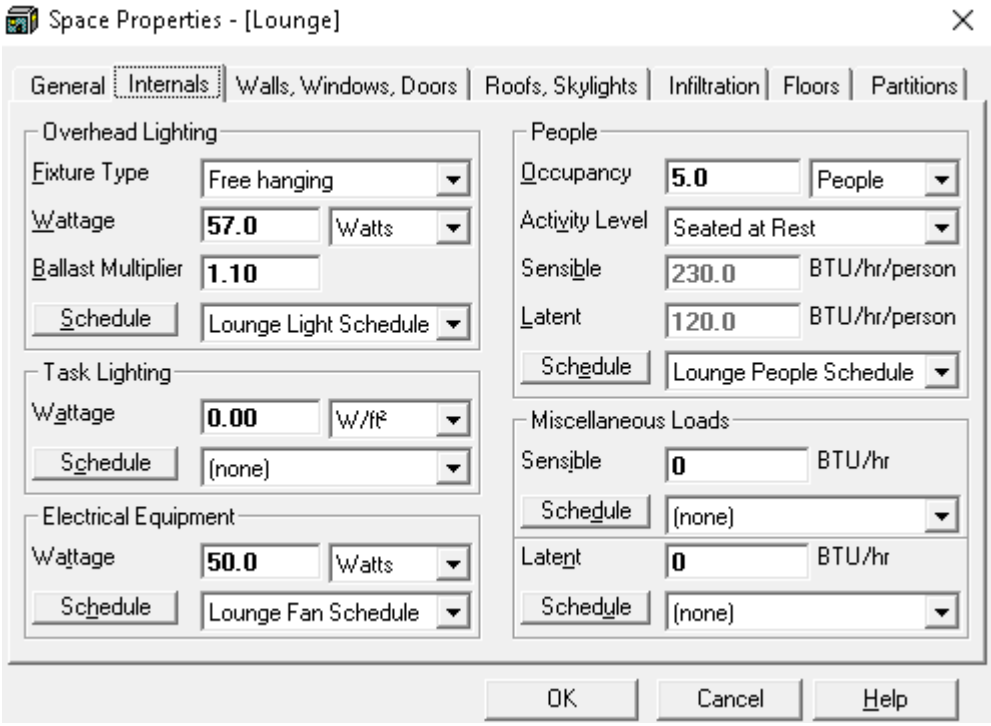
f. Electrical Equipment and Number of Occupants

The calculations and details of the Overhead Lighting Wattage, Electrical Equipment Wattage, and Occupancy for all Spaces can be found in the Rooms/Spaces Data Table provided under the I. Construction Plan section


Space Properties - [Bedroom 1]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Overhead Lighting
Fixture Type
Free hanging
Wattage
57.0
Watts
Ballast Multiplier
1.10
Schedule
BD1 Light Schedule
Task Lighting
Wattage
0.00
W/ft²
Schedule
(none)
Electrical Equipment
Wattage
50.0
Watts
Schedule
BD1 Fan Schedule
People
Occupancy
2.0
People
Activity Level
Seated at Rest
Sensible
230.0
BTU/hr/person
Latent
120.0
BTU/hr/person
Schedule
BD1 People Schedule
Miscellaneous Loads
Sensible
0
BTU/hr
Schedule
(none)
Latent
0
BTU/hr
Schedule
(none)
OK
Cancel
Help


Space Properties - [Bedroom 2]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Overhead Lighting
Fixture Type
Recessed, unvented
Wattage
169.0
Watts
Ballast Multiplier
1.10
Schedule
BD2 Light Schedule
Task Lighting
Wattage
0.00
W/ft²
Schedule
(none)
Electrical Equipment
Wattage
50.0
Watts
Schedule
BD2 Fan Schedule
People
Occupancy
3.0
People
Activity Level
Seated at Rest
Sensible
230.0
BTU/hr/person
Latent
120.0
BTU/hr/person
Schedule
BD2 People Schedule
Miscellaneous Loads
Sensible
0
BTU/hr
Schedule
(none)
Latent
0
BTU/hr
Schedule
(none)
OK
Cancel
Help


Space Properties - [Kitchen]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Overhead Lighting
Fixture Type
Free hanging
Wattage
31.0
Watts
Ballast Multiplier
1.10
Schedule
Kitchen Light Schedule
Task Lighting
Wattage
0.00
W/ft²
Schedule
(none)
Electrical Equipment
Wattage
0.0
Watts
Schedule
(none)
People
Occupancy
2.0
People
Activity Level
Sedentary Work
Sensible
280.0
BTU/hr/person
Latent
270.0
BTU/hr/person
Schedule
Kitchen People Schedule
Miscellaneous Loads
Sensible
0
BTU/hr
Schedule
(none)
Latent
0
BTU/hr
Schedule
(none)
OK
Cancel
Help


Space Properties - [Lounge]
General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Overhead Lighting
Fixture Type
Free hanging
Wattage
57.0
Watts
Ballast Multiplier
1.10
Schedule
Lounge Light Schedule
Task Lighting
Wattage
0.00
W/ft²
Schedule
(none)
Electrical Equipment
Wattage
50.0
Watts
Schedule
Lounge Fan Schedule
People
Occupancy
5.0
People
Activity Level
Seated at Rest
Sensible
230.0
BTU/hr/person
Latent
120.0
BTU/hr/person
Schedule
Lounge People Schedule
Miscellaneous Loads
Sensible
0
BTU/hr
Schedule
(none)
Latent
0
BTU/hr
Schedule
(none)
OK
Cancel
Help

III. Estimated Heat-Transfer Coefficients

a. The Heat Transfer Coefficients for all Building Components

Wall Properties - [Wall]

Wall Assembly Name: Wall

Outside Surface Color: Light Absorptivity: 0.450

Layers: Inside to Outside	Thickness in	Density lb/ft³	Specific Ht. BTU / (lb·°F)	R-Value (hr·ft²·°F)/BTU	Weight lb/ft²
Inside surface resistance	0.000	0.0	0.00	0.68500	0.0
Plaster	0.374	78.0	0.26	0.12515	2.4
Brick	6.000	124.9	0.20	1.21712	62.5
Plaster	0.374	78.0	0.26	0.12515	2.4
Outside surface resistance	0.000	0.0	0.00	0.33297	0.0
Totals	6.748			2.49	67.3

Overall U-Value: 0.402 BTU/(hr·ft²·°F)

OK Cancel Help

Roof Properties - [Roof]

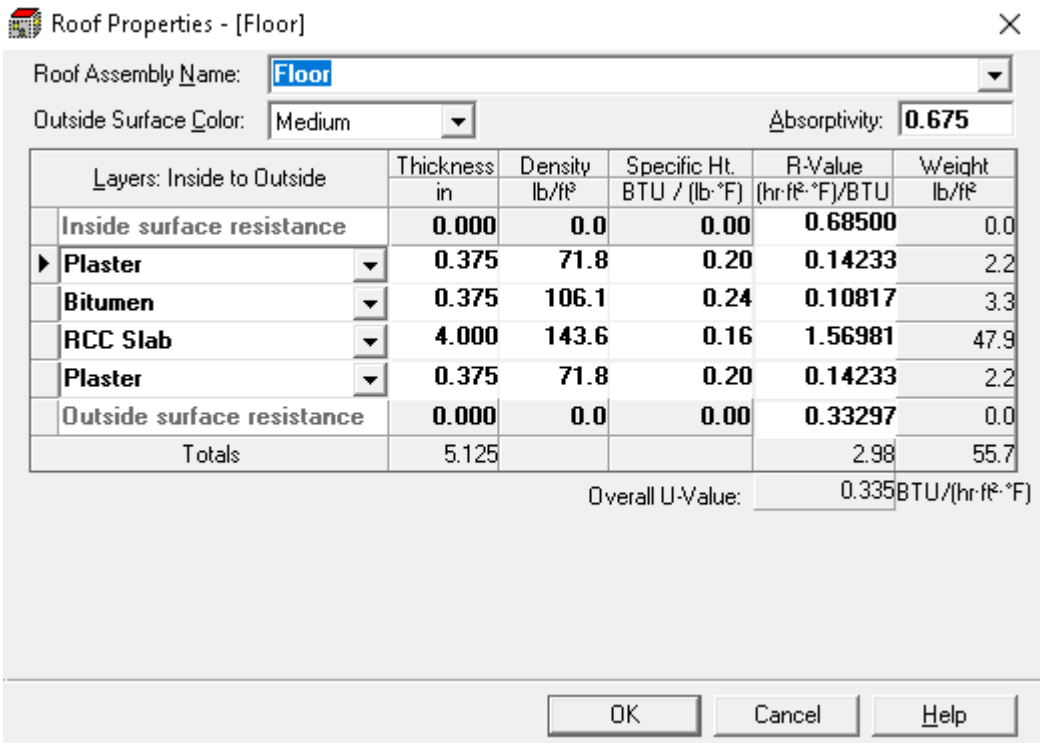
Roof Assembly Name: Roof

Outside Surface Color: Medium Absorptivity: 0.675

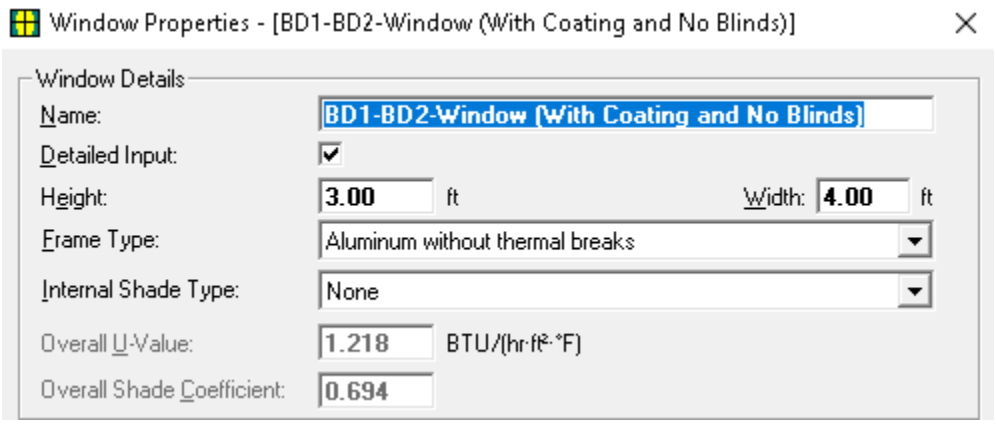
Layers: Inside to Outside	Thickness in	Density lb/ft³	Specific Ht. BTU / (lb·°F)	R-Value (hr·ft²·°F)/BTU	Weight lb/ft²
Inside surface resistance	0.000	0.0	0.00	0.68500	0.0
Plaster	0.375	71.8	0.20	0.14233	2.2
Bitumen	0.375	106.1	0.24	0.10817	3.3
RCC Slab	4.000	143.6	0.16	1.56981	47.9
Plaster	0.375	71.8	0.20	0.14233	2.2
Outside surface resistance	0.000	0.0	0.00	0.33297	0.0
Totals	5.125			2.98	55.7

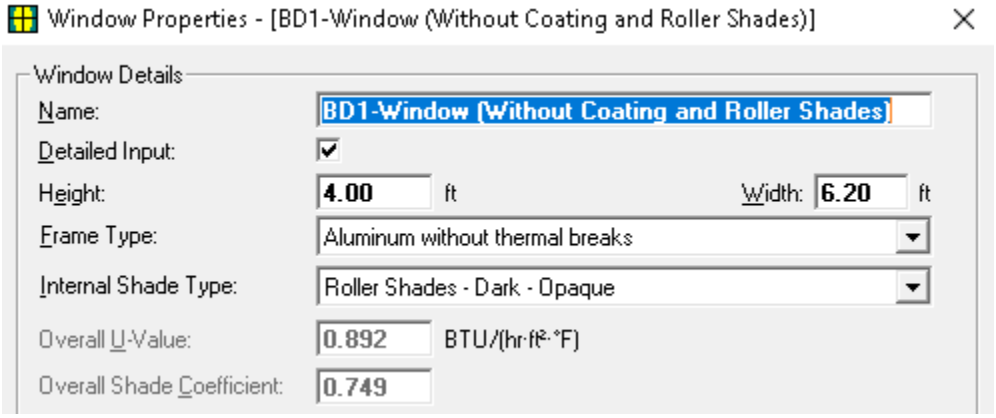
Overall U-Value: 0.335 BTU/(hr·ft²·°F)

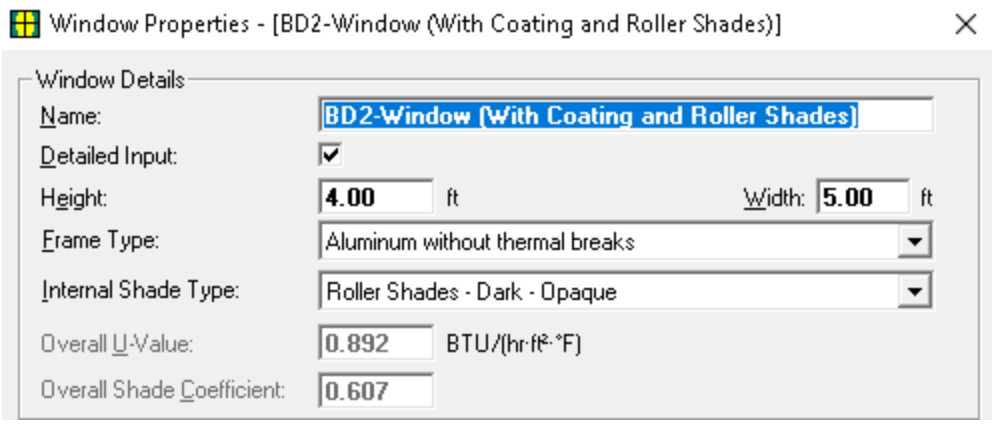
OK Cancel Help

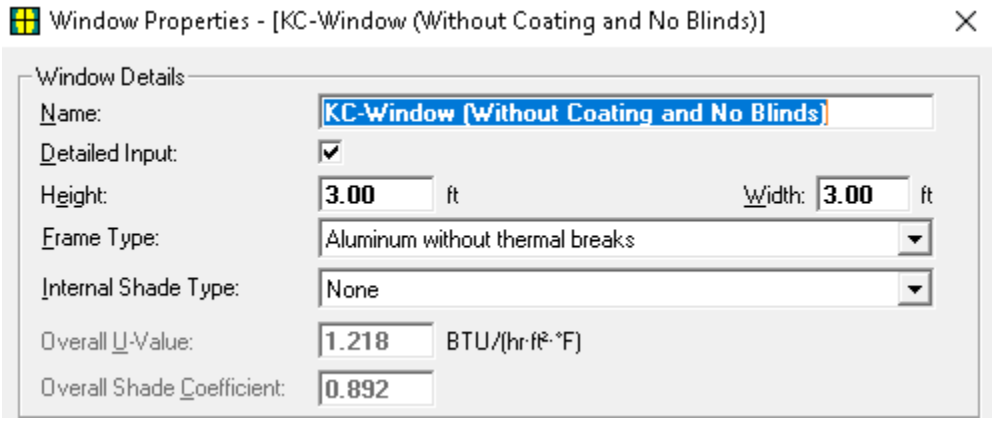


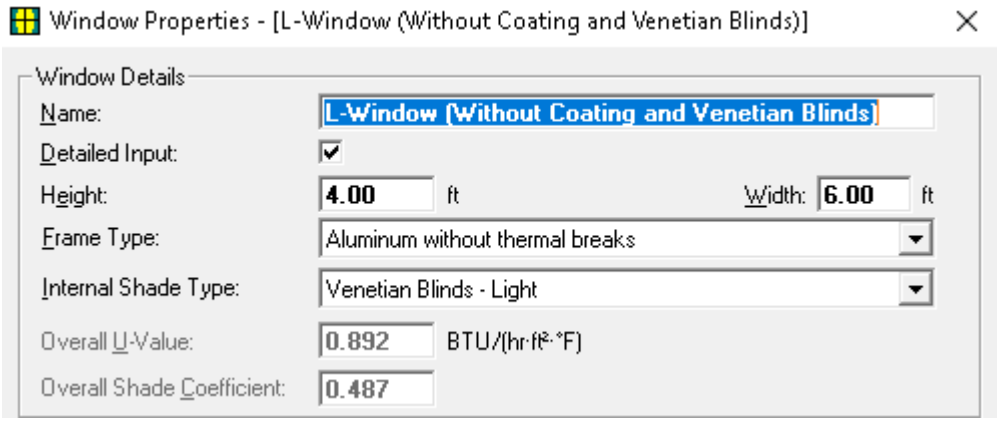
b. The Heat Transfer Coefficients for Windows







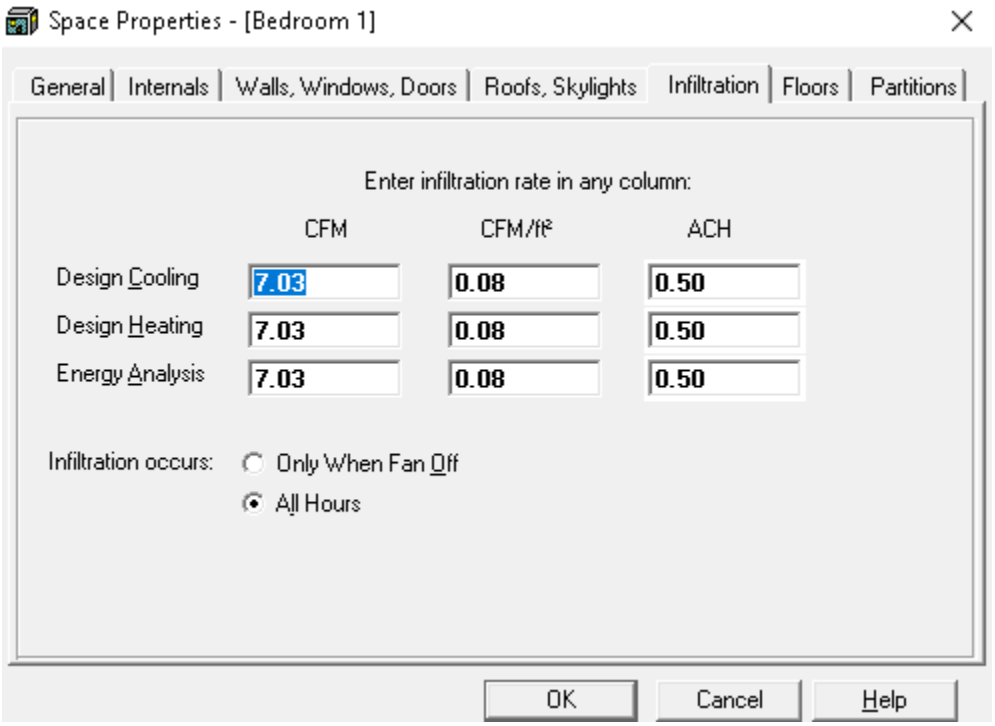




c. The Heat Transfer Coefficient for Door

During the analysis, it was determined that no doors were required, and therefore there is no need to consider heat transfer coefficients for doors

IV. Infiltration Requirements

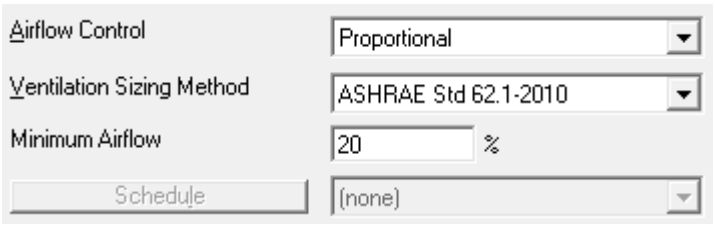


V. Ventilation Requirements

The details for this section can be found in section II.c.

VI. Selection of Parameters of Air-Conditioning System

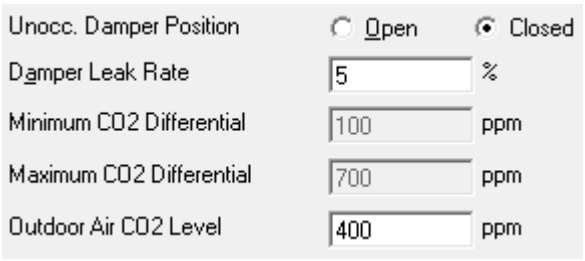
a. Airflow Control Type



b. Appropriate Ventilation Sizing Method

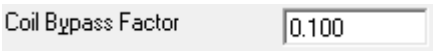
The details for this section can be found in section VI.a.

c. Damper Leak Rate

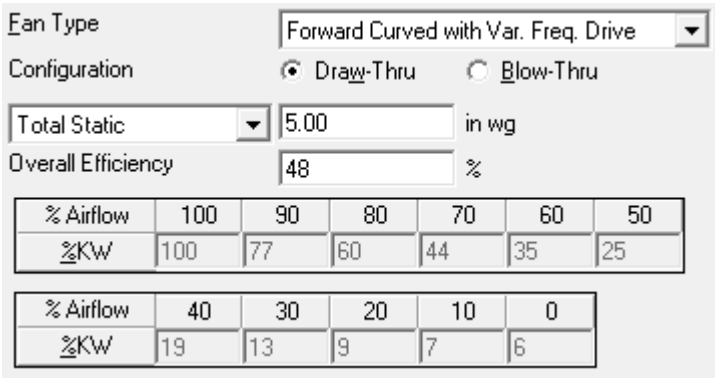


d. Supply Temperature

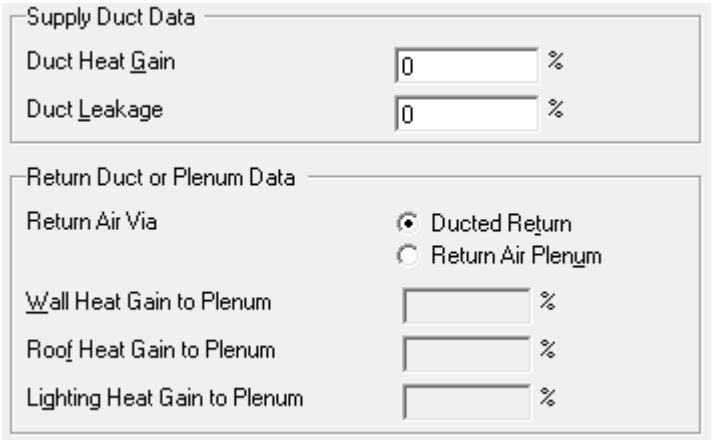
e. Coil Bypass Factor



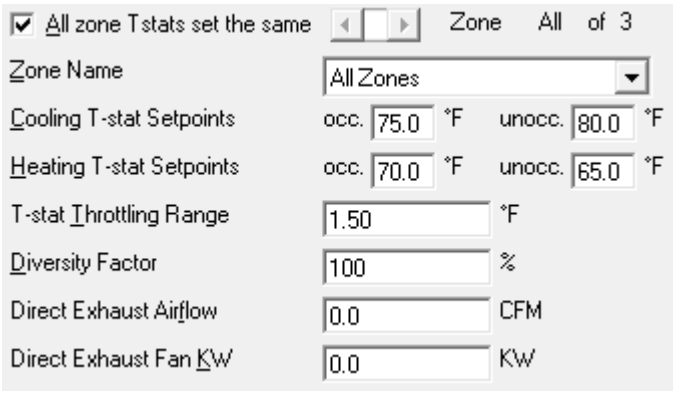
f. Supply Fan Type, Configuration and Fan Full Load Performance Value



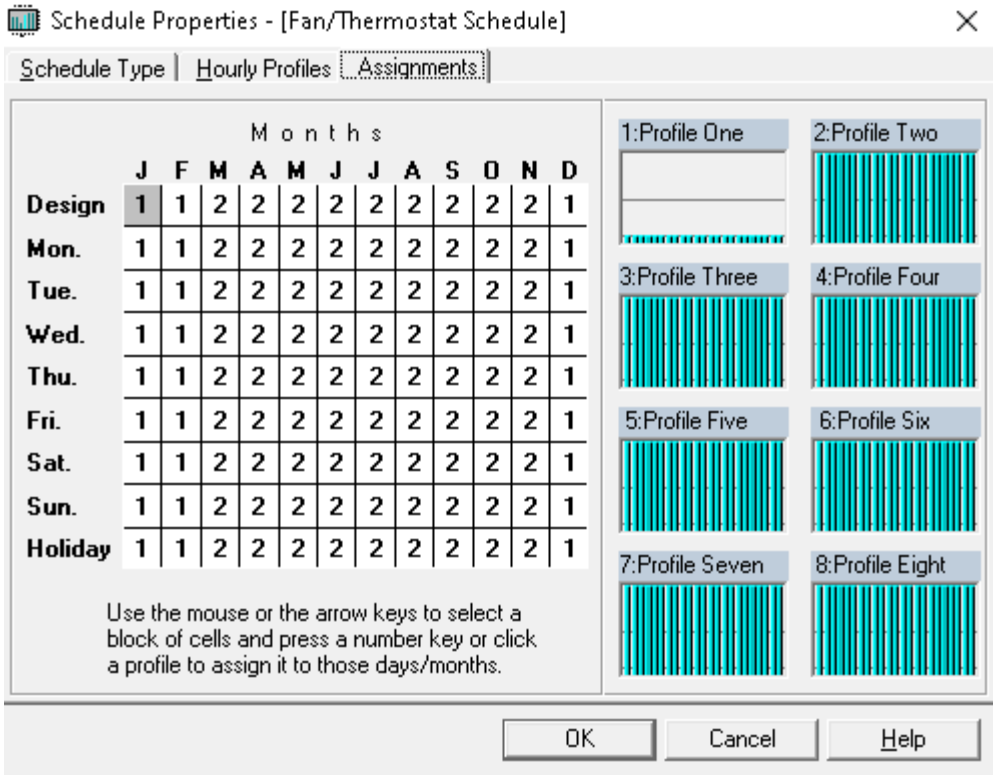
g. Type of Duct System Zone Components



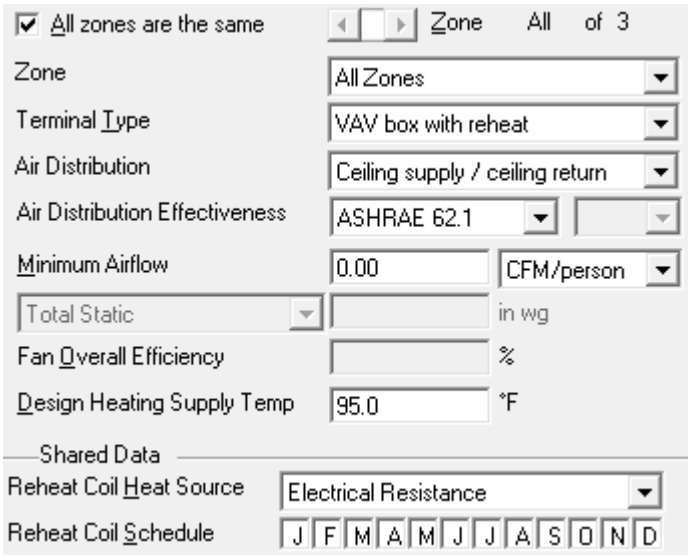
h. Diversity Factor of Loads



i. Thermostat Schedule



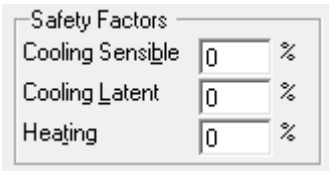
j. Terminal Type



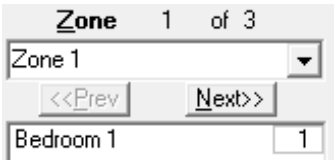
k. Minimum Airflow Sizing Data

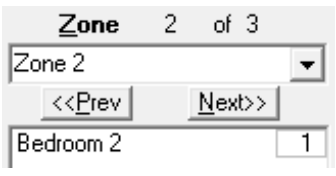
The details for this section can be found in section VI.j.

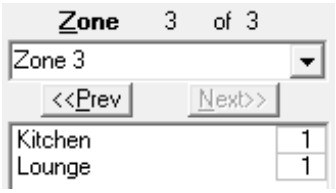
l. Safety Factors for Sizing



VII. Estimation of Cooling Load







Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Oct 1500 COOLING OA DB / WB 96.0 °F / 80.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	25 ft²	3344	-	25 ft²	-	-
Wall Transmission	60 ft²	550	-	60 ft²	505	-
Roof Transmission	96 ft²	1257	-	96 ft²	676	-
Window Transmission	25 ft²	409	-	25 ft²	465	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	96 ft²	445	-	96 ft²	0	-
Partitions	85 ft²	471	-	85 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	44 W	142	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	20 W	74	-	0	0	-
People	1	239	96	0	0	0
Infiltration	-	159	339	-	159	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	7091	435	-	1805	0

Zone 2	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 98.6 °F / 81.7 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	153 ft²	2855	-	153 ft²	1079	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	153 ft²	864	-	153 ft²	0	-
Partitions	253 ft²	1714	-	253 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	130 W	410	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	50 W	160	-	0	0	-
People	1	348	144	0	0	0
Infiltration	-	286	608	-	255	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	6636	752	-	1333	0

Zone 3	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 98.6 °F / 81.7 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	33 ft²	804	-	33 ft²	-	-
Wall Transmission	130 ft²	1438	-	130 ft²	1095	-
Roof Transmission	206 ft²	3841	-	206 ft²	1451	-
Window Transmission	33 ft²	707	-	33 ft²	680	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	206 ft²	1163	-	206 ft²	0	-
Partitions	253 ft²	1714	-	253 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	87 W	280	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	50 W	160	-	0	0	-
People	5	1085	852	0	0	0
Infiltration	-	385	819	-	342	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	**11576**	**1671**	-	**3569**	**0**

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 99.6 °F / 81.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	58 ft²	3235	-	58 ft²	-	-
Wall Transmission	189 ft²	1951	-	189 ft²	1600	-
Roof Transmission	455 ft²	7999	-	455 ft²	3205	-
Window Transmission	58 ft²	1219	-	58 ft²	1145	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	455 ft²	2648	-	455 ft²	0	-
Partitions	591 ft²	4124	-	591 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	261 W	829	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	120 W	392	-	0	0	-
People	7	1661	1092	0	0	0
Infiltration	-	885	1814	-	756	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	**24945**	**2906**	-	**6707**	**0**
Zone Conditioning	-	23687	2906	-	5772	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	1032 CFM	0	-	249 CFM	0	-
Ventilation Load	95 CFM	2382	5145	195 CFM	4133	0
Supply Fan Load	1032 CFM	3655	-	249 CFM	-463	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	**29724**	**8051**	-	**9442**	**0**
Central Cooling Coil	-	29724	8052	-	0	0
Terminal Reheat Coils	-	0	-	-	9442	-
>> Total Conditioning	-	**29724**	**8052**	-	**9442**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

VIII. Energy Requirements and Annual Operational Cost

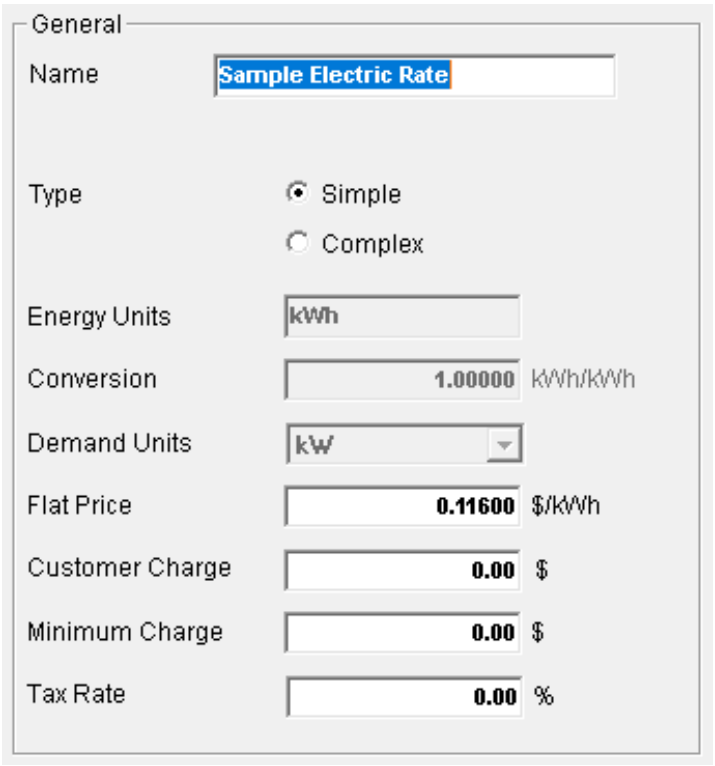


Table 1. Annual Costs

Component	Sample Building ($)
HVAC Components	
Electric	740
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**740**
Non-HVAC Components	
Electric	297
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**297**
Grand Total	**1,038**

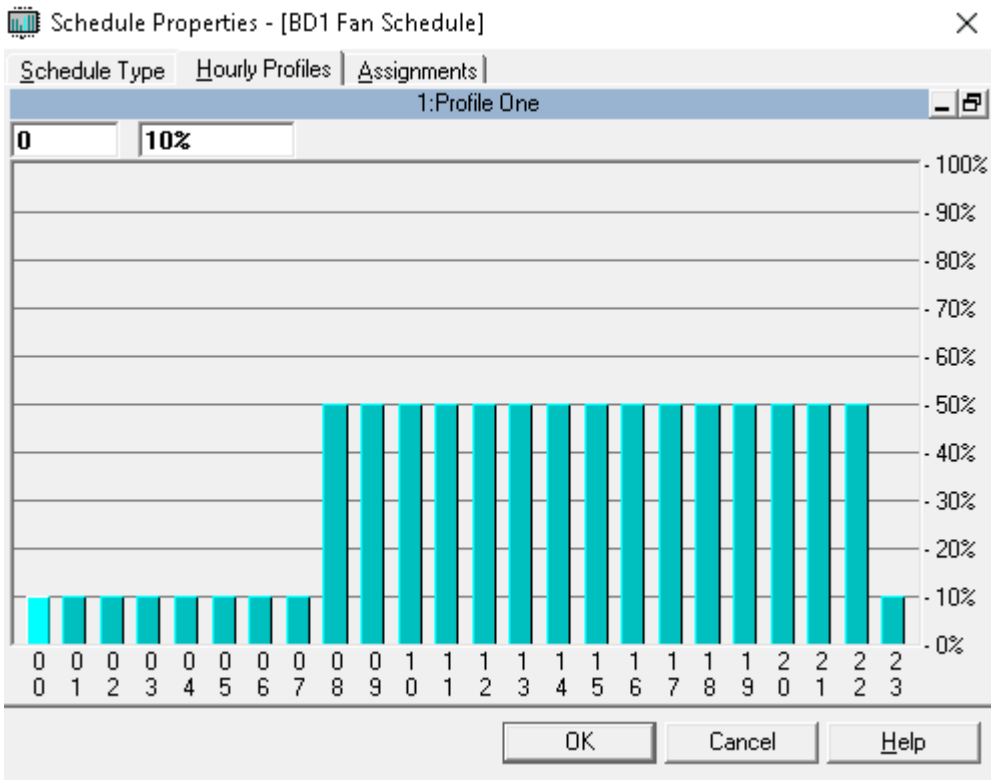
Table 2. Annual Energy Consumption

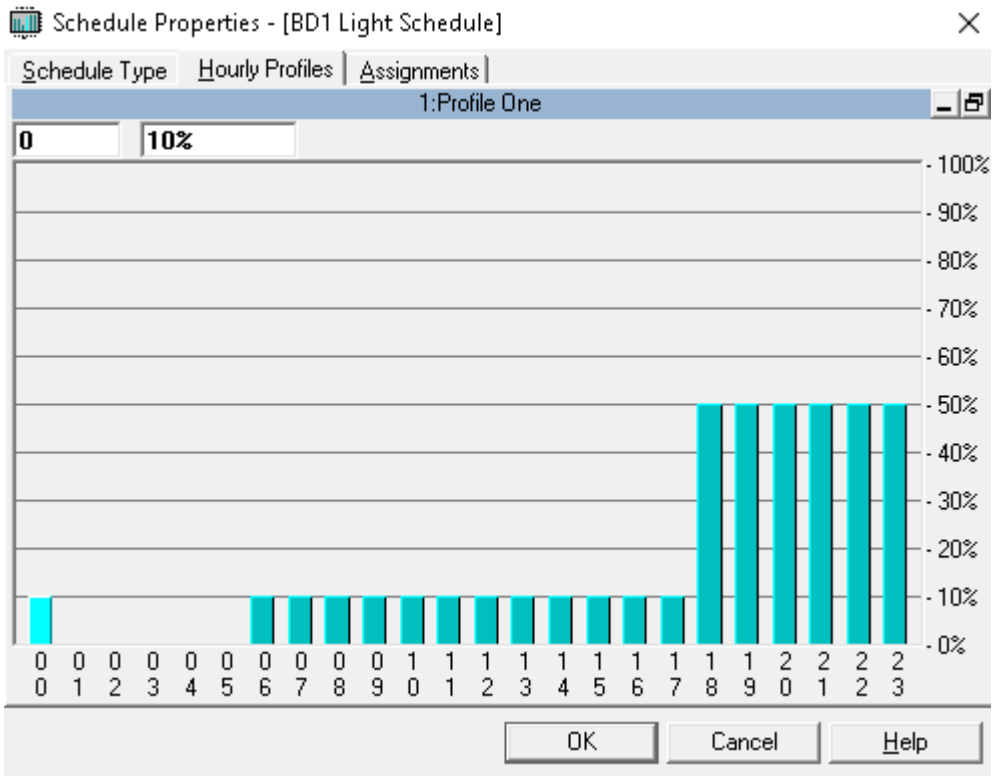
Component	Sample Building
HVAC Components	
Electric (kWh)	6,380
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	2,564
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	8,944
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

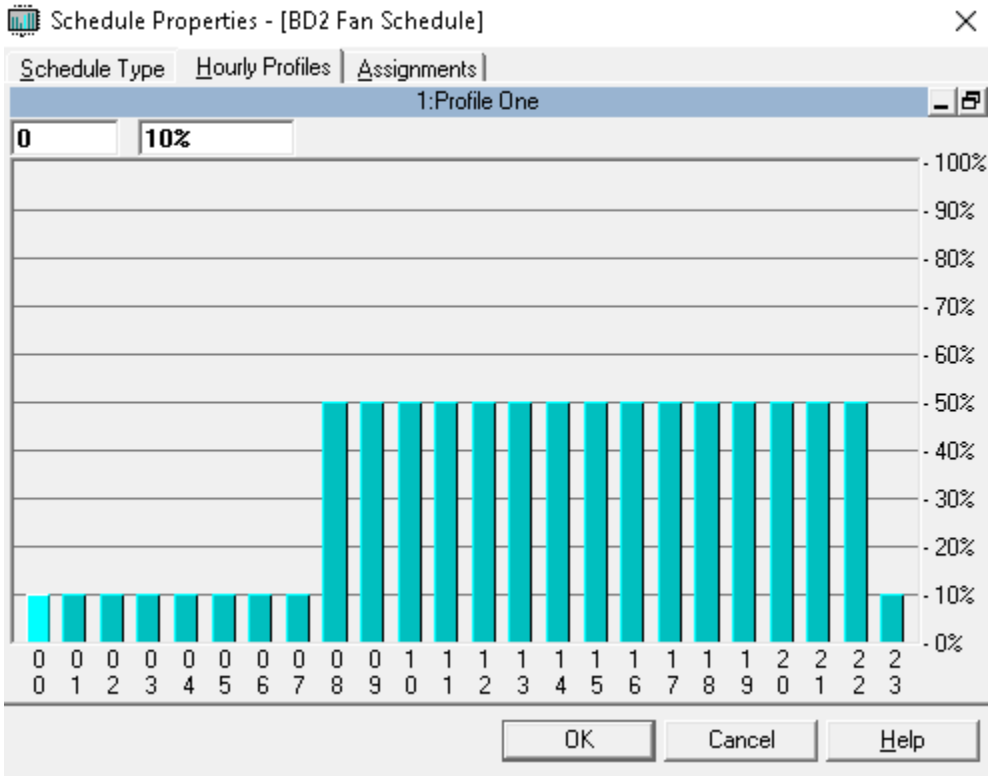
IX. Cost Saving Solution

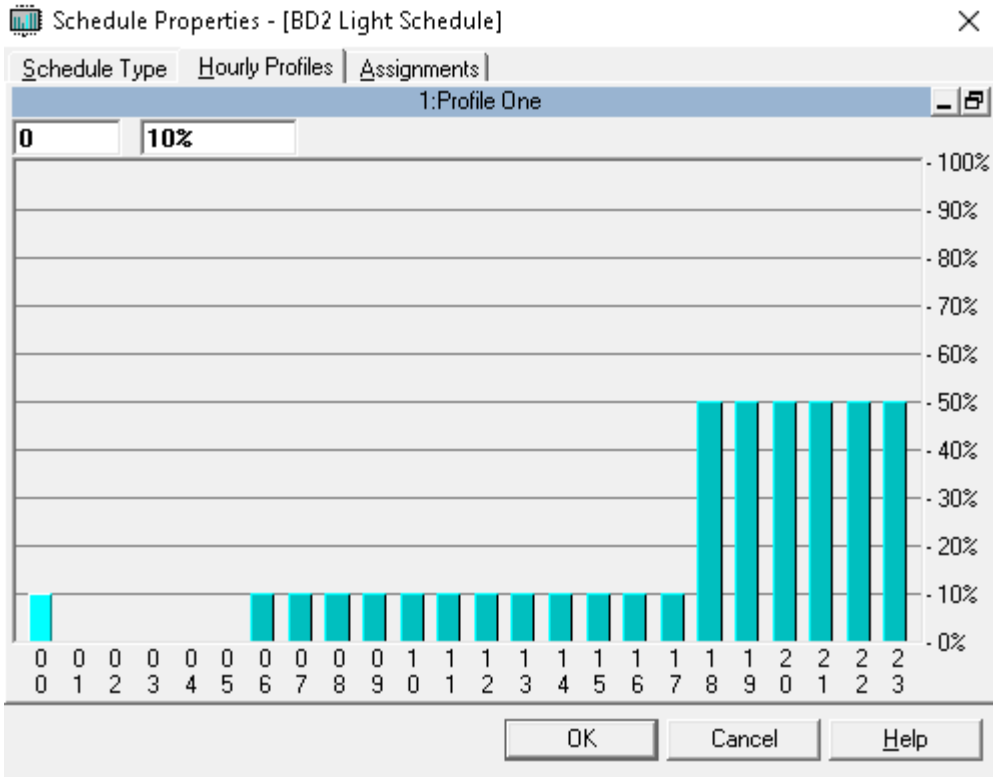
After analyzing the original Annual Costs Table, we identified a cost of $1038. Our objective was to reduce this cost by approximately 15% by implementing modifications in various areas such as routine, wattages, and windows.

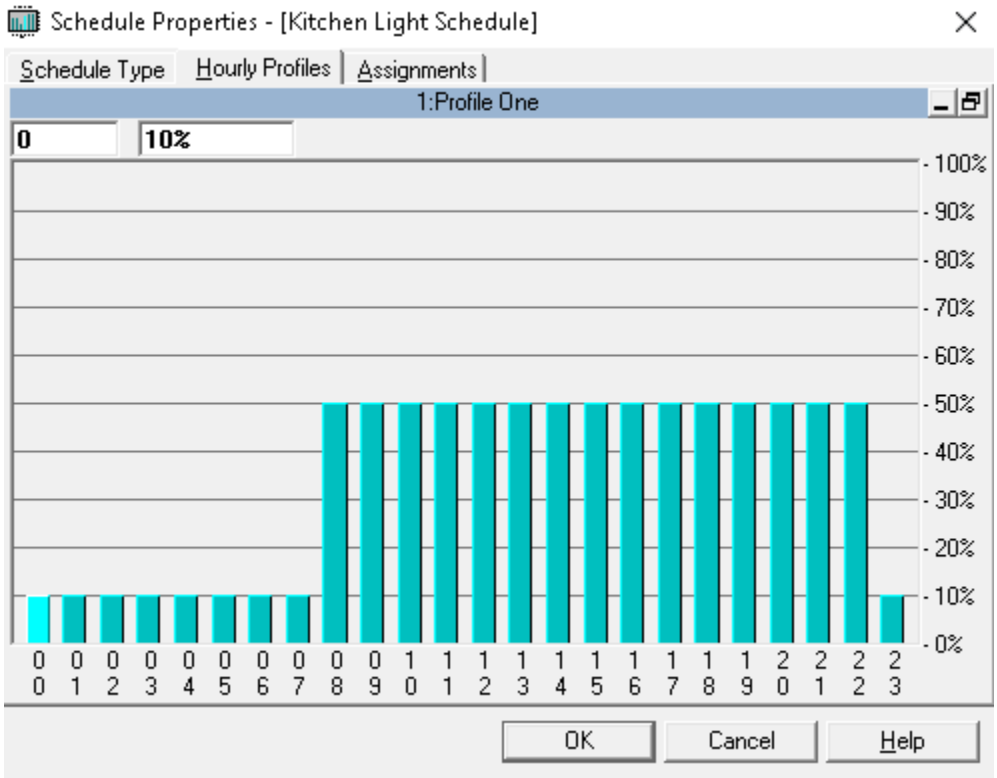
One significant modification we made was optimizing the schedule to align with real-life usage patterns. Additionally, we addressed the issue of two specific windows, the Lounge Window and the Kitchen Window, which were not coated and contributed to increased heating and subsequent higher annual costs. By applying a coating to these windows, we were able to calculate a modified Annual Cost of $843. This cost is significantly lower than the original amount and exceeds our initial 15% reduction goal.

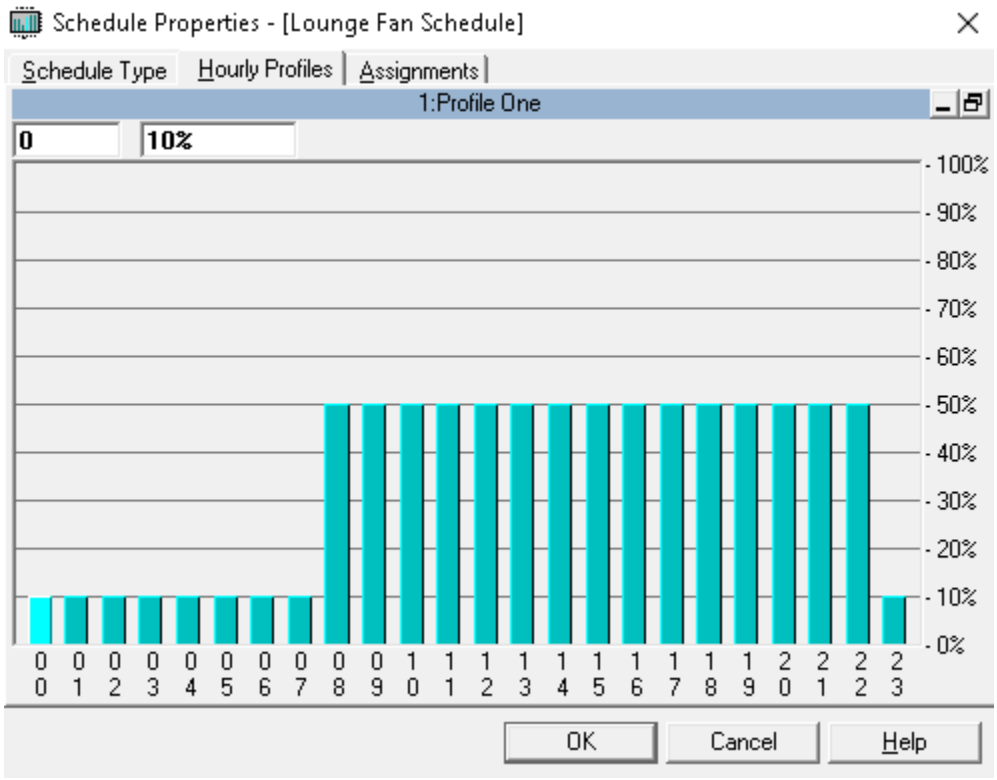


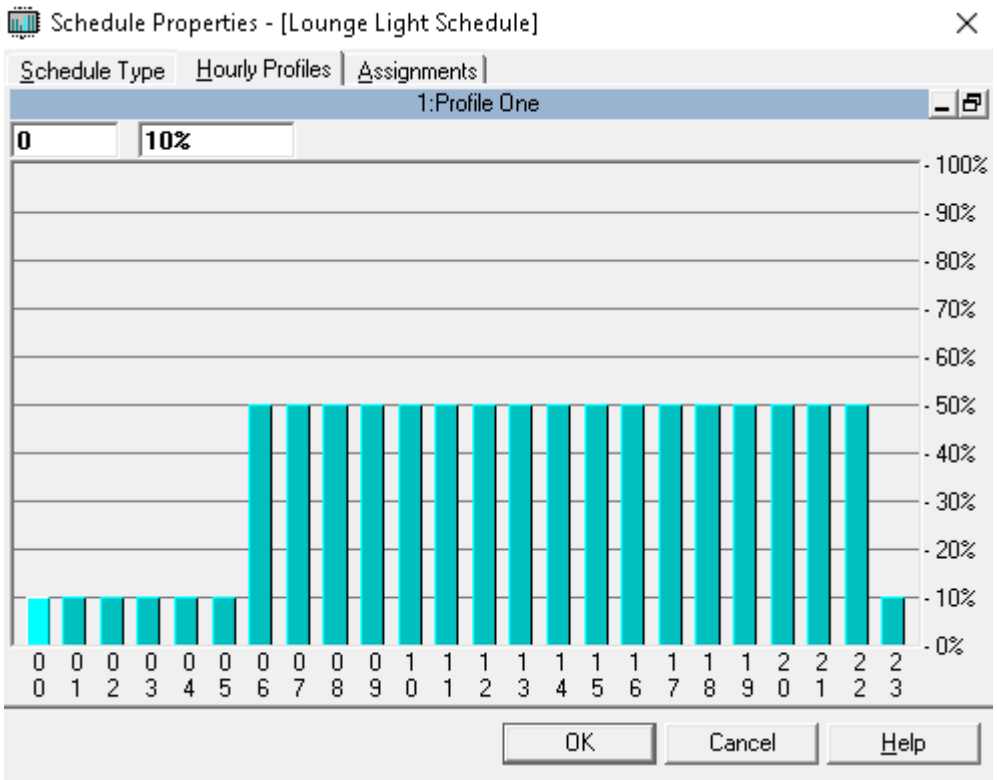

Schedule Properties - [BD1 Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help

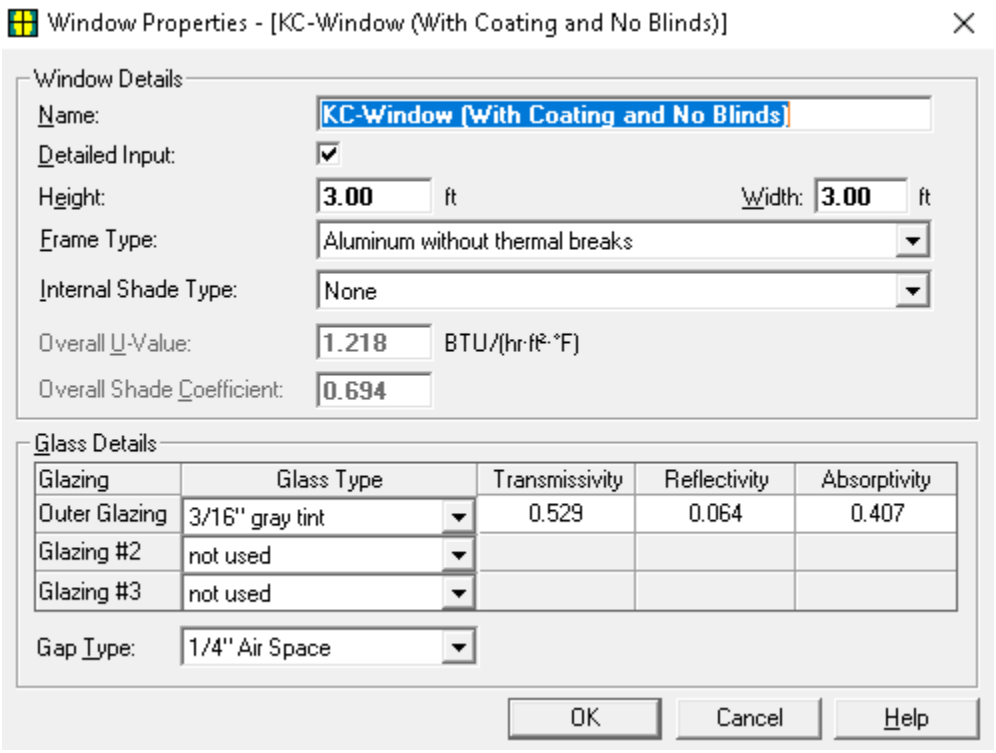

Schedule Properties - [BD2 Fan Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Schedule Properties - [BD2 Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Schedule Properties - [Kitchen Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Schedule Properties - [Lounge Fan Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Schedule Properties - [Lounge Light Schedule]
Schedule Type
Hourly Profiles
Assignments
1:Profile One
0
10%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
OK
Cancel
Help


Window Properties - [KC-Window (With Coating and No Blinds)]
Window Details
Name: KC-Window (With Coating and No Blinds)
Detailed Input:
Height: 3.00 ft
Width: 3.00 ft
Frame Type: Aluminum without thermal breaks
Internal Shade Type: None
Overall U-Value: 1.218 BTU/(hr·ft²·°F)
Overall Shade Coefficient: 0.694
Glass Details
Glazing | Glass Type | Transmissivity | Reflectivity | Absorptivity
Outer Glazing | 3/16" gray tint | 0.529 | 0.064 | 0.407
Glazing #2 | not used
Glazing #3 | not used
Gap Type: 1/4" Air Space
OK
Cancel
Help

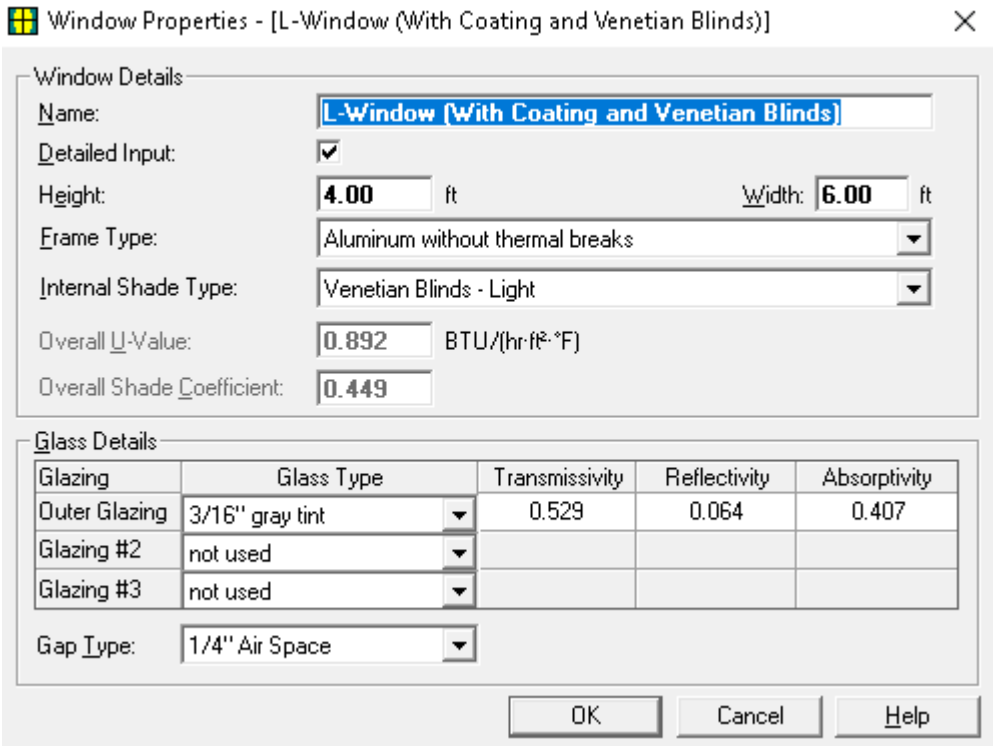

Window Properties - [L-Window (With Coating and Venetian Blinds)]
Window Details
Name: L-Window (With Coating and Venetian Blinds)
Detailed Input:
Height: 4.00 ft
Width: 6.00 ft
Frame Type: Aluminum without thermal breaks
Internal Shade Type: Venetian Blinds - Light
Overall U-Value: 0.892 BTU/(hr·ft²·°F)
Overall Shade Coefficient: 0.449
Glass Details
Glazing | Glass Type | Transmissivity | Reflectivity | Absorptivity
Outer Glazing | 3/16" gray tint | 0.529 | 0.064 | 0.407
Glazing #2 | not used
Glazing #3 | not used
Gap Type: 1/4" Air Space
OK
Cancel
Help

Table 1. Annual Costs

Component	Sample Building ($)
HVAC Components	
Electric	708
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**708**
Non-HVAC Components	
Electric	135
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**135**
Grand Total	**843**

Table 2. Annual Energy Consumption

Component	Sample Building
HVAC Components	
Electric (kWh)	6,106
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	1,165
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	7,271
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Bedroom 1

1. General Details:

Floor Area	**95.9**	ft²
Avg. Ceiling Height	**8.8**	ft
Building Weight	**70.0**	lb/ft²

1.1. OA Ventilation Requirements:

Space Usage	**HOTEL: Bedroom/living room**	
OA Requirement 1	**5.0**	CFM/person
OA Requirement 2	**0.06**	CFM/ft²
Space Usage Defaults	**ASHRAE Standard 62.1-2010**	

2. Internals:

2.1. Overhead Lighting:

Fixture Type	**Free Hanging**	
Wattage	**57.0**	Watts
Ballast Multiplier	**1.10**	
Schedule	**BD1 Light Schedule**	

2.2. Task Lighting:

Wattage	**0.00**	W/ft²
Schedule	**None**	

2.3. Electrical Equipment:

Wattage	**50.0**	Watts
Schedule	**BD1 Fan Schedule**	

2.4. People:

Occupancy	**2.0**	People
Activity Level	**Seated at Rest**	
Sensible	**230.0**	BTU/hr/person
Latent	**120.0**	BTU/hr/person
Schedule	**BD1 People Schedule**	

2.5. Miscellaneous Loads:

Sensible	**0**	BTU/hr
Schedule	**None**	
Latent	**0**	BTU/hr
Schedule	**None**	

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	84.6	1	0	0

3.1. Construction Types for Exposure SW

Wall Type	**Wall**
1st Window Type	**BD1-Window (Without Coating and Roller Shades)**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	95.9	0	0

4.1. Construction Types for Exposure H

Roof Type	**Roof**

5. Infiltration:

Design Cooling	**0.50**	ACH
Design Heating	**0.50**	ACH
Energy Analysis	**0.50**	ACH

Infiltration occurs at all hours.

6. Floors:

Type	**Floor Above Unconditioned Space**	
Floor Area	**95.9**	ft²
Total Floor U-Value	**0.335**	BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.	**95.0**	°F
Ambient at Space Max Temp.	**100.0**	°F
Unconditioned Space Min Temp.	**81.0**	°F
Ambient at Space Min Temp.	**86.0**	°F

7. Partitions:

7.1. 1st Partition Details:

Partition Type	**Wall Partition**	
Area	**84.6**	ft²
U-Value	**0.402**	BTU/(hr·ft²·°F)
Uncondit. Space Max Temp	**95.0**	°F
Ambient at Space Max Temp	**100.0**	°F
Uncondit. Space Min Temp	**81.0**	°F
Ambient at Space Min Temp	**86.0**	°F

7.2. 2nd Partition Details:

(No partition data).

Bedroom 2

1. General Details:

Floor Area	**153.1**	ft²
Avg. Ceiling Height	**8.8**	ft
Building Weight	**70.0**	lb/ft²

1.1. OA Ventilation Requirements:

Space Usage	**HOTEL: Bedroom/living room**	
OA Requirement 1	**5.0**	CFM/person
OA Requirement 2	**0.06**	CFM/ft²
Space Usage Defaults	**ASHRAE Standard 62.1-2010**	

2. Internals:

2.1. Overhead Lighting:

Fixture Type	**Recessed (Unvented)**	
Wattage	**169.0**	Watts
Ballast Multiplier	**1.10**	
Schedule	**BD2 Light Schedule**	

2.2. Task Lighting:

Wattage	**0.00**	W/ft²
Schedule	**None**	

2.3. Electrical Equipment:

Wattage	**50.0**	Watts
Schedule	**BD2 Fan Schedule**	

2.4. People:

Occupancy	**3.0**	People
Activity Level	**Seated at Rest**	
Sensible	**230.0**	BTU/hr/person
Latent	**120.0**	BTU/hr/person
Schedule	**BD2 People Schedule**	

2.5. Miscellaneous Loads:

Sensible	**0**	BTU/hr
Schedule	**None**	
Latent	**0**	BTU/hr
Schedule	**None**	

3. Walls, Windows, Doors:

(No Wall, Window, Door data).

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	153.1	0	0

4.1. Construction Types for Exposure H

Roof Type	**Roof**

5. Infiltration:

Design Cooling	**0.50**	ACH
Design Heating	**0.50**	ACH
Energy Analysis	**0.50**	ACH

Infiltration occurs at all hours.

6. Floors:

Type	**Floor Above Unconditioned Space**	
Floor Area	**153.1**	ft²
Total Floor U-Value	**0.335**	BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.	**95.0**	°F
Ambient at Space Max Temp.	**100.0**	°F
Unconditioned Space Min Temp.	**81.0**	°F
Ambient at Space Min Temp.	**86.0**	°F

7. Partitions:

7.1. 1st Partition Details:

Partition Type	**Wall Partition**	
Area	**253.0**	ft²
U-Value	**0.402**	BTU/(hr·ft²·°F)
Uncondit. Space Max Temp	**95.0**	°F
Ambient at Space Max Temp	**100.0**	°F
Uncondit. Space Min Temp	**81.0**	°F
Ambient at Space Min Temp	**86.0**	°F

7.2. 2nd Partition Details:

(No partition data).

Kitchen

1. General Details:

Floor Area	**40.3**	ft²
Avg. Ceiling Height	**8.8**	ft
Building Weight	**70.0**	lb/ft²

1.1. OA Ventilation Requirements:

Space Usage	**FOOD SERVICE: Kitchen (cooking)**	
OA Requirement 1	**7.5**	CFM/person
OA Requirement 2	**0.12**	CFM/ft²
Space Usage Defaults	**ASHRAE Standard 62.1-2010**	

2. Internals:

2.1. Overhead Lighting:

Fixture Type	**Free Hanging**	
Wattage	**31.0**	Watts
Ballast Multiplier	**1.10**	
Schedule	**Kitchen Light Schedule**	

2.2. Task Lighting:

Wattage	**0.00**	W/ft²
Schedule	**None**	

2.3. Electrical Equipment:

Wattage	**0.0**	Watts
Schedule	**None**	

2.4. People:

Occupancy	**2.0**	People
Activity Level	**Sedentary Work**	
Sensible	**280.0**	BTU/hr/person
Latent	**270.0**	BTU/hr/person
Schedule	**Kitchen People Schedule**	

2.5. Miscellaneous Loads:

Sensible	**0**	BTU/hr
Schedule	**None**	
Latent	**0**	BTU/hr
Schedule	**None**	

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	50.3	1	0	0
NW	30.6	0	0	0

3.1. Construction Types for Exposure SW

Wall Type	**Wall**
1st Window Type	**KC-Window (Without Coating and No Blinds)**

3.2. Construction Types for Exposure NW

Wall Type	**Wall**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	40.3	0	0

4.1. Construction Types for Exposure H

Roof Type	**Roof**

5. Infiltration:

Design Cooling	**0.50**	ACH
Design Heating	**0.50**	ACH
Energy Analysis	**0.50**	ACH

Infiltration occurs at all hours.

6. Floors:

Type	**Floor Above Unconditioned Space**	
Floor Area	**40.3**	ft²
Total Floor U-Value	**0.335**	BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.	**95.0**	°F
Ambient at Space Max Temp.	**100.0**	°F
Unconditioned Space Min Temp.	**81.0**	°F
Ambient at Space Min Temp.	**86.0**	°F

7. Partitions:

7.1. 1st Partition Details:

Partition Type	**Wall Partition**	
Area	**30.6**	ft²
U-Value	**0.402**	BTU/(hr·ft²·°F)
Uncondit. Space Max Temp	**95.0**	°F
Ambient at Space Max Temp	**100.0**	°F
Uncondit. Space Min Temp	**81.0**	°F
Ambient at Space Min Temp	**86.0**	°F

7.2. 2nd Partition Details: **(No partition data).**

Lounge

1. General Details:
Floor Area ..... **165.7** ft²
Avg. Ceiling Height ..... **8.8** ft
Building Weight ..... **70.0** lb/ft²

1.1. OA Ventilation Requirements:
Space Usage ..... **HOTEL: Bedroom/living room**
OA Requirement 1 ..... **5.0** CFM/person
OA Requirement 2 ..... **0.06** CFM/ft²
Space Usage Defaults .. **ASHRAE Standard 62.1-2010**

2. Internals:
2.1. Overhead Lighting:
Fixture Type ..... **Free Hanging**
Wattage ..... **57.0** Watts
Ballast Multiplier **1.10**
Schedule ..... **Lounge Light Schedule**

2.2. Task Lighting:
Wattage ..... **0.00** W/ft²
Schedule ..... **None**

2.3. Electrical Equipment:
Wattage ..... **50.0** Watts
Schedule ..... **Lounge Fan Schedule**

2.4. People:
Occupancy ..... **5.0** People
Activity Level ..... **Seated at Rest**
Sensible ..... **230.0** BTU/hr/person
Latent ..... **120.0** BTU/hr/person
Schedule ..... **Lounge People Schedule**

2.5. Miscellaneous Loads:
Sensible ..... **0** BTU/hr
Schedule ..... **None**
Latent ..... **0** BTU/hr
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
NE	81.7	1	0	0

3.1. Construction Types for Exposure NE
Wall Type ..... **Wall**
1st Window Type . **L-Window (Without Coating and Venetian Blinds)**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	165.7	0	0

4.1. Construction Types for Exposure H
Roof Type ..... **Roof**

5. Infiltration:
Design Cooling ..... **0.50** ACH
Design Heating ..... **0.50** ACH
Energy Analysis ..... **0.50** ACH
Infiltration occurs at all hours.

6. Floors:
Type ..... **Floor Above Unconditioned Space**
Floor Area ..... **165.7** ft²
Total Floor U-Value ..... **0.335** BTU/(hr·ft²·°F)
Unconditioned Space Max Temp. ..... **95.0** °F
Ambient at Space Max Temp. ..... **100.0** °F
Unconditioned Space Min Temp. ..... **81.0** °F
Ambient at Space Min Temp. ..... **86.0** °F

7. Partitions:
7.1. 1st Partition Details:
Partition Type ..... **Wall Partition**
Area ..... **222.4** ft²
U-Value ..... **0.402** BTU/(hr·ft²·°F)
Uncondit. Space Max Temp ..... **95.0** °F
Ambient at Space Max Temp ..... **100.0** °F
Uncondit. Space Min Temp ..... **81.0** °F
Ambient at Space Min Temp ..... **86.0** °F

7.2. 2nd Partition Details:
(No partition data).

Air System Sizing Summary for System 1 (VAV)

Project Name: HAP Original
Prepared by: Kamil

06/22/2023
12:29PM

Air System Information

Air System Name	**System 1 (VAV)**		Number of zones	**3**	
Equipment Class	**PKG ROOF**		Floor Area	**455.0**	ft²
Air System Type	**VAV**		Location	**Karachi, Pakistan**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**		Zone CFM Sizing	**Peak zone sensible load**	
Sizing Data	**Calculated**		Space CFM Sizing	**Individual peak space loads**	

Central Cooling Coil Sizing Data

Total coil load	**3.1**	Tons	Load occurs at	**Aug 1600**	
Total coil load	**37.8**	MBH	OA DB / WB	**99.6 / 81.9**	°F
Sensible coil load	**29.7**	MBH	Entering DB / WB	**78.4 / 63.5**	°F
Coil CFM at Aug 1600	**1032**	CFM	Leaving DB / WB	**51.7 / 50.4**	°F
Max block CFM at Aug 1600	**1155**	CFM	Coil ADP	**48.8**	°F
Sum of peak zone CFM	**1172**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.787**		Resulting RH	**42**	%
CFM/Ton	**327.9**		Design supply temp.	**55.0**	°F
ft²/Ton	**144.5**		Zone T-stat Check	**3 of 3**	OK
BTU/(hr·ft²)	**83.0**		Max zone temperature deviation	**0.0**	°F
Water flow @ 10.0 °F rise	**N/A**				

Supply Fan Sizing Data

Actual max CFM at Aug 1600	**1155**	CFM	Fan motor BHP	**1.78**	BHP
Standard CFM	**1155**	CFM	Fan motor kW	**1.41**	kW
Actual max CFM/ft²	**2.54**	CFM/ft²	Fan static	**5.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**106**	CFM	CFM/person	**10.49**	CFM/person
CFM/ft²	**0.23**	CFM/ft²			

Zone Sizing Summary for System 1 (VAV)

Project Name: HAP Original
Prepared by: Kamil

06/22/2023
12:29PM

Air System Information

Air System Name ..... **System 1 (VAV)**
Equipment Class ..... **PKG ROOF**
Air System Type ..... **VAV**

Number of zones **3**
Floor Area ..... **455.0** ft²
Location ..... **Karachi, Pakistan**

Sizing Calculation Information

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

Zone CFM Sizing ..... **Peak zone sensible load**
Space CFM Sizing ..... **Individual peak space loads**

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/ft²	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 20.0 °F	Zone Htg Unit Coil Load (MBH)	Zone Htg Unit Water gpm @ 20.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	328	67	3.42	2.9	-	0.0	-	0
Zone 2	307	49	2.01	2.1	-	0.0	-	0
Zone 3	536	132	2.60	5.7	-	0.0	-	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)
Zone 1	7.1	Oct 1500	1.8	95.9
Zone 2	6.6	Jul 1700	1.3	153.1
Zone 3	11.6	Jul 1700	3.6	206.0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Bedroom 1	1	7.1	Oct 1500	328	1.8	95.9	3.42
Zone 2							
Bedroom 2	1	6.6	Jul 1700	307	1.3	153.1	2.01
Zone 3							
Kitchen	1	3.3	Aug 1700	153	1.2	40.3	3.80
Lounge	1	8.4	Jul 1600	389	2.4	165.7	2.35

Ventilation Sizing Summary for System 1 (VAV)

Project Name: HAP Original
Prepared by: Kamil

06/22/2023
12:29PM

1. Summary

Ventilation Sizing Method ..... **ASHRAE Std 62.1-2010**
Design Condition ..... **Minimum flow (heating)**
Occupant Diversity (D) **1.000**
Uncorrected Outdoor Air Intake (Vou) ..... **84** CFM
System Ventilation Efficiency (Ev) **0.795**
Outdoor Air Intake (Vot) ..... **106** CFM

2. Space Ventilation Analysis

		Minimum Supply Air (CFM)	Space Floor Area (ft^2)	Area Outdoor Air Rate (CFM/ft^2)	Time Averaged Occupancy (Occupants)	People Outdoor Air Rate (CFM/person)	Air Distribution Effectiveness	Space Outdoor Air (CFM)	Breathing Zone Outdoor Air (CFM)	Space Ventilation Efficiency
Zone Name / Space Name	**Mult.**	**(Vpz)**	**(Az)**	**(Ra)**	**(Pz)**	**(Rp)**	**(Ez)**	**(Voz)**	**(Vbz)**	**(Evz)**
Zone 1										
Bedroom 1	1	20	95.9	0.06	2.0	5.00	0.8	**20**	*16*	0.795
Zone 2										
Bedroom 2	1	30	153.1	0.06	3.0	5.00	0.8	**30**	*24*	0.795
Zone 3										
Kitchen	1	21	40.3	0.12	1.6	7.50	0.8	**21**	*17*	0.795
Lounge	1	35	165.7	0.06	3.5	5.00	0.8	**34**	*27*	0.813
Totals (incl. Space Multipliers)		**106**							**84**	**0.795**

Air System Design Load Summary for System 1 (VAV)

Project Name: HAP Original
Prepared by: Kamil

06/22/2023
12:29PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 99.6 °F / 81.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	58 ft²	3235	-	58 ft²	-	-
Wall Transmission	189 ft²	1951	-	189 ft²	1600	-
Roof Transmission	455 ft²	7999	-	455 ft²	3205	-
Window Transmission	58 ft²	1219	-	58 ft²	1145	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	455 ft²	2648	-	455 ft²	0	-
Partitions	591 ft²	4124	-	591 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	261 W	829	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	120 W	392	-	0	0	-
People	7	1661	1092	0	0	0
Infiltration	-	885	1814	-	756	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**24945**	**2906**	**-**	**6707**	**0**
Zone Conditioning	-	23687	2906	-	5772	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	1032 CFM	0	-	249 CFM	0	-
Ventilation Load	95 CFM	2382	5145	195 CFM	4133	0
Supply Fan Load	1032 CFM	3655	-	249 CFM	-463	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**29724**	**8051**	**-**	**9442**	**0**
Central Cooling Coil	-	29724	8052	-	0	0
Terminal Reheat Coils	-	0	-	-	9442	-
>> Total Conditioning	**-**	**29724**	**8052**	**-**	**9442**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Oct 1500 COOLING OA DB / WB 96.0 °F / 80.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	25 ft²	3344	-	25 ft²	-	-
Wall Transmission	60 ft²	550	-	60 ft²	505	-
Roof Transmission	96 ft²	1257	-	96 ft²	676	-
Window Transmission	25 ft²	409	-	25 ft²	465	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	96 ft²	445	-	96 ft²	0	-
Partitions	85 ft²	471	-	85 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	44 W	142	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	20 W	74	-	0	0	-
People	1	239	96	0	0	0
Infiltration	-	159	339	-	159	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**7091**	**435**	**-**	**1805**	**0**

Zone 2	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 98.6 °F / 81.7 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	153 ft²	2855	-	153 ft²	1079	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	153 ft²	864	-	153 ft²	0	-
Partitions	253 ft²	1714	-	253 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	130 W	410	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	50 W	160	-	0	0	-
People	1	348	144	0	0	0
Infiltration	-	286	608	-	255	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**6636**	**752**	**-**	**1333**	**0**

Zone 3	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 98.6 °F / 81.7 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	33 ft²	804	-	33 ft²	-	-
Wall Transmission	130 ft²	1438	-	130 ft²	1095	-
Roof Transmission	206 ft²	3841	-	206 ft²	1451	-
Window Transmission	33 ft²	707	-	33 ft²	680	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	206 ft²	1163	-	206 ft²	0	-
Partitions	253 ft²	1714	-	253 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	87 W	280	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	50 W	160	-	0	0	-
People	5	1085	852	0	0	0
Infiltration	-	385	819	-	342	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**11576**	**1671**	**-**	**3569**	**0**

ZONE: Zone 1
DESIGN MONTH: JULY

Hour	OA TEMP (°F)	ZONE TEMP (°F)	RH (%)	ZONE AIRFLOW (CFM)	ZONE SENSIBLE LOAD (BTU/hr)	ZONE COND (BTU/hr)	TERMINAL COOLING COIL (BTU/hr)	TERMINAL HEATING COIL (BTU/hr)	ZONE HEATING UNIT (BTU/hr)
0000	88.5	75.5	46	160.8	3604.8	3561.6	0.0	0.0	0.0
0100	87.8	75.4	46	148.2	3295.2	3270.1	0.0	0.0	0.0
0200	87.1	75.4	47	140.4	3110.1	3093.0	0.0	0.0	0.0
0300	86.6	75.4	47	133.6	2947.8	2937.0	0.0	0.0	0.0
0400	86.1	75.3	48	127.6	2806.6	2800.5	0.0	0.0	0.0
0500	86.0	75.3	48	122.8	2694.9	2691.5	0.0	0.0	0.0
0600	86.3	75.3	48	126.3	2787.1	2771.6	0.0	0.0	0.0
0700	87.0	75.4	49	131.5	2917.4	2888.5	0.0	0.0	0.0
0800	88.2	75.3	47	130.7	2899.9	2869.5	0.0	0.0	0.0
0900	90.1	75.4	47	139.8	3128.4	3078.5	0.0	0.0	0.0
1000	92.2	75.5	46	152.0	3431.3	3358.4	0.0	0.0	0.0
1100	94.5	75.6	46	167.3	3812.5	3712.4	0.0	0.0	0.0
1200	96.8	75.6	45	184.0	4228.6	4100.5	0.0	0.0	0.0
1300	98.5	75.8	44	211.3	4918.5	4744.2	0.0	0.0	0.0
1400	99.6	76.0	43	241.8	5701.1	5476.9	0.0	0.0	0.0
1500	100.0	76.1	42	264.0	6271.7	6016.1	0.0	0.0	0.0
1600	99.6	76.2	42	272.9	6494.2	6233.6	0.0	0.0	0.0
1700	98.6	76.1	42	266.1	6302.8	6066.7	0.0	0.0	0.0
1800	97.1	76.0	43	237.4	5543.2	5370.4	0.0	0.0	0.0
1900	95.2	75.8	43	207.3	4763.1	4649.5	0.0	0.0	0.0
2000	93.4	75.7	44	197.1	4503.9	4407.5	0.0	0.0	0.0
2100	91.9	75.7	45	187.6	4265.6	4184.7	0.0	0.0	0.0
2200	90.5	75.6	45	175.8	3971.9	3909.7	0.0	0.0	0.0
2300	89.4	75.6	46	169.9	3826.9	3771.4	0.0	0.0	0.0

ZONE: Zone 2
DESIGN MONTH: JULY

Hour	OA TEMP (°F)	ZONE TEMP (°F)	RH (%)	ZONE AIRFLOW (CFM)	ZONE SENSIBLE LOAD (BTU/hr)	ZONE COND (BTU/hr)	TERMINAL COOLING COIL (BTU/hr)	TERMINAL HEATING COIL (BTU/hr)	ZONE HEATING UNIT (BTU/hr)
0000	88.5	75.8	46	187.3	4309.6	4200.5	0.0	0.0	0.0
0100	87.8	75.7	46	168.2	3814.9	3752.0	0.0	0.0	0.0
0200	87.1	75.6	47	158.4	3570.9	3524.1	0.0	0.0	0.0
0300	86.6	75.6	47	149.9	3360.9	3326.4	0.0	0.0	0.0
0400	86.1	75.5	48	142.5	3182.2	3156.6	0.0	0.0	0.0
0500	86.0	75.5	48	136.9	3049.4	3027.8	0.0	0.0	0.0
0600	86.3	75.5	48	143.2	3222.5	3172.1	0.0	0.0	0.0
0700	87.0	75.5	49	143.3	3232.5	3174.1	0.0	0.0	0.0
0800	88.2	75.5	47	146.1	3311.9	3238.7	0.0	0.0	0.0
0900	90.1	75.6	47	156.3	3583.3	3475.7	0.0	0.0	0.0
1000	92.2	75.7	46	172.0	3993.8	3839.7	0.0	0.0	0.0
1100	94.5	75.8	46	192.2	4526.1	4315.8	0.0	0.0	0.0
1200	96.8	75.9	45	214.0	5103.1	4835.6	0.0	0.0	0.0
1300	98.5	76.1	44	234.3	5642.4	5325.3	0.0	0.0	0.0
1400	99.6	76.2	43	251.8	6108.4	5752.2	0.0	0.0	0.0
1500	100.0	76.2	42	264.8	6451.0	6070.9	0.0	0.0	0.0
1600	99.6	76.3	42	271.6	6624.1	6239.0	0.0	0.0	0.0
1700	98.6	76.3	42	272.6	6636.4	6263.0	0.0	0.0	0.0
1800	97.1	76.3	43	267.1	6472.6	6128.1	0.0	0.0	0.0
1900	95.2	76.2	43	256.1	6159.4	5857.1	0.0	0.0	0.0
2000	93.4	76.1	44	241.3	5747.3	5494.5	0.0	0.0	0.0
2100	91.9	76.0	45	225.6	5320.6	5115.0	0.0	0.0	0.0
2200	90.5	75.9	45	210.3	4910.9	4747.5	0.0	0.0	0.0
2300	89.4	75.8	46	198.4	4598.3	4464.1	0.0	0.0	0.0

Hourly Zone Loads for System 1 (VAV)

ZONE: Zone 3
DESIGN MONTH: JULY

Hour	OA TEMP (°F)	ZONE TEMP (°F)	RH (%)	ZONE AIRFLOW (CFM)	ZONE SENSIBLE LOAD (BTU/hr)	ZONE COND (BTU/hr)	TERMINAL COOLING COIL (BTU/hr)	TERMINAL HEATING COIL (BTU/hr)	ZONE HEATING UNIT (BTU/hr)
0000	88.5	75.6	46	311.4	7047.6	6937.6	0.0	0.0	0.0
0100	87.8	75.6	46	292.5	6565.5	6494.9	0.0	0.0	0.0
0200	87.1	75.5	47	274.8	6117.8	6083.5	0.0	0.0	0.0
0300	86.6	75.4	47	259.1	5722.6	5718.5	0.0	0.0	0.0
0400	86.1	75.4	48	245.1	5376.3	5397.0	0.0	0.0	0.0
0500	86.0	75.4	48	233.7	5098.1	5136.3	0.0	0.0	0.0
0600	86.3	75.4	48	249.3	5507.3	5493.1	0.0	0.0	0.0
0700	87.0	75.6	49	301.1	6854.0	6696.3	0.0	0.0	0.0
0800	88.2	75.7	47	320.4	7358.8	7150.4	0.0	0.0	0.0
0900	90.1	75.7	47	330.8	7631.9	7395.8	0.0	0.0	0.0
1000	92.2	75.8	46	342.3	7934.4	7668.0	0.0	0.0	0.0
1100	94.5	75.8	46	358.9	8374.2	8064.6	0.0	0.0	0.0
1200	96.8	75.9	45	386.0	9094.7	8715.2	0.0	0.0	0.0
1300	98.5	76.0	44	416.7	9917.5	9460.6	0.0	0.0	0.0
1400	99.6	76.1	43	444.1	10655.9	10132.9	0.0	0.0	0.0
1500	100.0	76.2	42	465.0	11222.0	10652.0	0.0	0.0	0.0
1600	99.6	76.3	42	476.7	11533.3	10943.0	0.0	0.0	0.0
1700	98.6	76.3	42	478.7	11576.5	10992.6	0.0	0.0	0.0
1800	97.1	76.2	43	468.4	11280.5	10736.3	0.0	0.0	0.0
1900	95.2	76.2	43	450.2	10770.7	10285.2	0.0	0.0	0.0
2000	93.4	76.1	44	430.0	10211.8	9787.4	0.0	0.0	0.0
2100	91.9	76.0	45	407.3	9592.9	9233.3	0.0	0.0	0.0
2200	90.5	75.9	45	384.4	8974.7	8677.5	0.0	0.0	0.0
2300	89.4	75.8	46	353.0	8137.6	7922.8	0.0	0.0	0.0

August DESIGN COOLING DAY, 1600

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	99.6	0.01952	95	400	2382	5145
Vent - Return Mixing	Outlet	78.4	0.00911	1032	862	-	-
Central Cooling Coil	Outlet	51.7	0.00746	1032	862	29724	8052
Supply Fan	Outlet	55.0	0.00746	1032	862	3655	-
Cold Supply Duct	Outlet	55.0	0.00746	1032	862	-	-
Zone Air	-	76.3	0.00805	1032	908	23687	2906
Return Plenum	Outlet	76.3	0.00805	1032	908	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.079 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4744.4 BTU/(hr-CFM)
Site Altitude = 13.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	6906	Cooling	6622	76.3	289	867	0	0
Zone 2	6567	Cooling	6185	76.3	269	874	0	0
Zone 3	11472	Cooling	10880	76.3	474	953	0	0

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

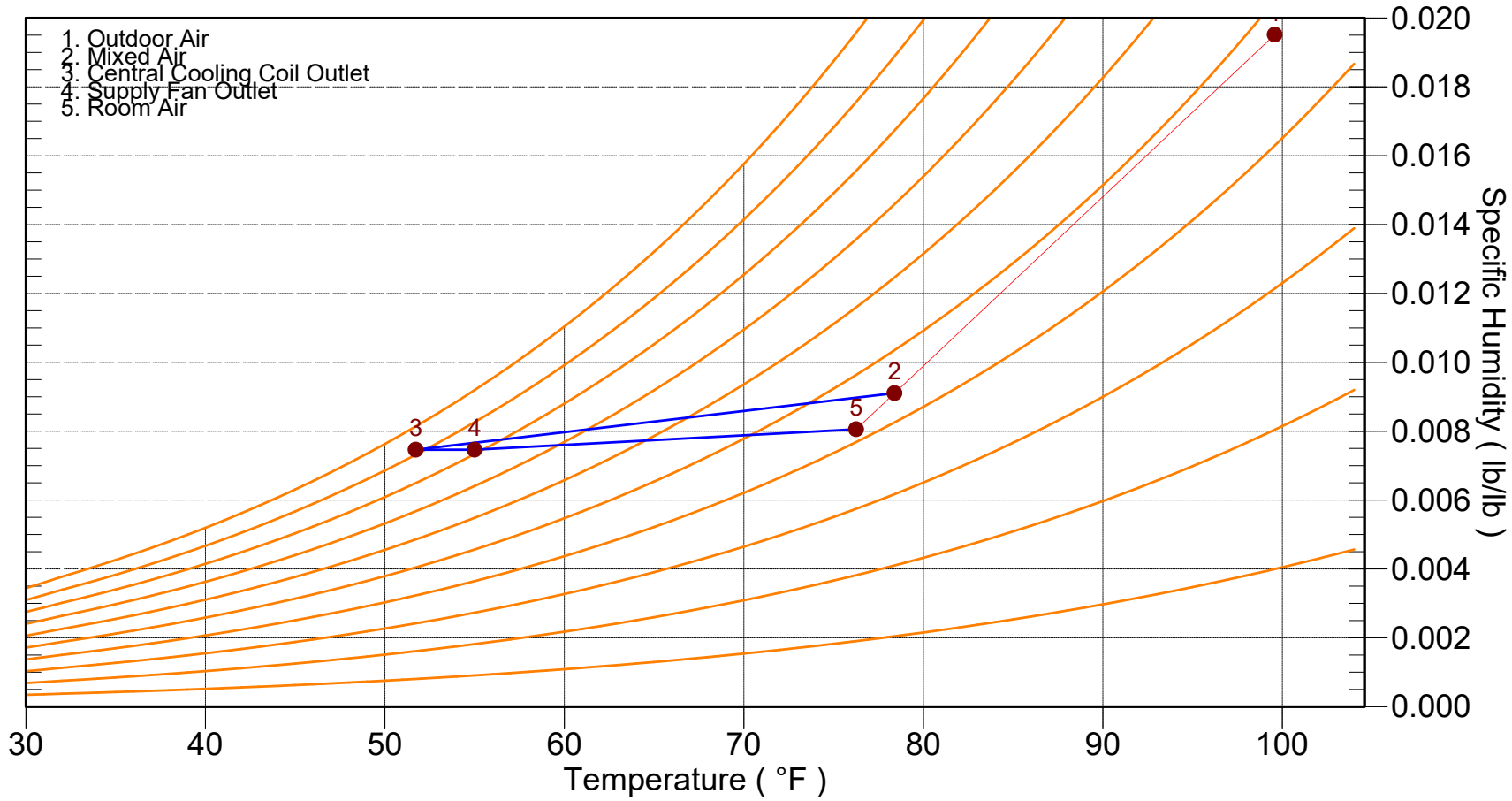
Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	49.0	0.00364	195	400	-4133	0
Vent - Return Mixing	Outlet	53.3	0.00364	249	401	-	-
Central Cooling Coil	Outlet	53.3	0.00364	249	401	0	0
Supply Fan	Outlet	55.0	0.00364	249	401	463	-
Cold Supply Duct	Outlet	55.0	0.00364	249	401	-	-
Zone Air	-	68.7	0.00364	249	404	-5772	0
Return Plenum	Outlet	68.7	0.00364	249	404	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.079 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4744.4 BTU/(hr-CFM)
Site Altitude = 13.0 ft

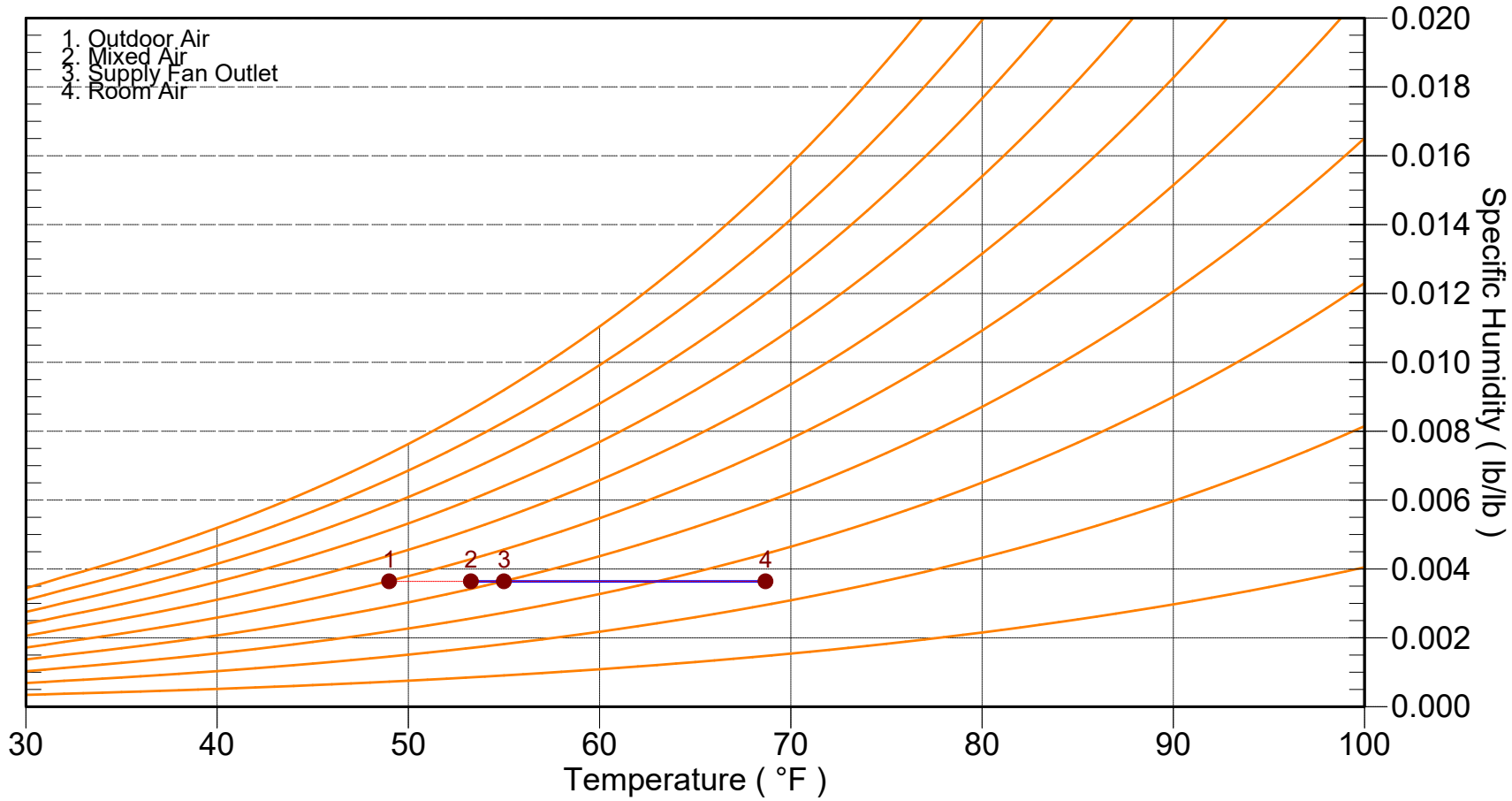
TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	-1805	Heating	-1601	68.7	67	404	2587	0
Zone 2	-1333	Heating	-1060	68.7	49	404	1793	0
Zone 3	-3569	Heating	-3112	68.7	132	404	5063	0

Location: Karachi, Pakistan
Altitude: 13.0 ft.
Data for: August DESIGN COOLING DAY, 1600



Location: Karachi, Pakistan
Altitude: 13.0 ft.
Data for: WINTER DESIGN HEATING



Monthly Simulation Results for System 1 (VAV)

Project Name: HAP Original
Prepared by: Kamil

06/22/2023
12:29PM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)	Supply Fan (kWh)	Lighting (kWh)
January	0	0	0	0	0	0	150
February	0	0	0	0	0	0	135
March	8869	8869	350	0	0	187	150
April	11399	11399	458	0	0	220	145
May	15308	15308	648	0	0	316	150
June	15242	15238	647	0	0	292	145
July	13131	13131	542	0	0	233	150
August	12264	12264	497	0	0	209	150
September	11596	11596	466	0	0	204	145
October	11045	11045	456	0	0	236	150
November	6860	6860	268	3	1	151	145
December	0	0	0	0	0	0	150
Total	**105715**	**105710**	**4332**	**3**	**1**	**2047**	**1761**

Air System Simulation Results (Table 2) :

Month	Electric Equipment (kWh)
January	68
February	62
March	68
April	66
May	68
June	66
July	68
August	68
September	66
October	68
November	66
December	68
Total	**803**

Daily Air System Simulation Results for July (Table 1) :

Day	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)	Supply Fan (kWh)	Lighting (kWh)
1	448	448	18	0	0	8	5
2	407	407	16	0	0	7	5
3	420	420	17	0	0	7	5
4	441	441	18	0	0	8	5
5	470	470	20	0	0	9	5
6	486	486	21	0	0	9	5
7	486	486	20	0	0	9	5
8	491	491	21	0	0	10	5
9	487	487	21	0	0	9	5
10	451	451	19	0	0	8	5
11	411	411	17	0	0	7	5
12	388	388	16	0	0	6	5
13	399	399	16	0	0	7	5
14	424	424	18	0	0	8	5
15	446	446	18	0	0	8	5
16	417	417	17	0	0	7	5
17	411	411	17	0	0	7	5
18	446	446	19	0	0	8	5
19	416	416	17	0	0	7	5
20	397	397	16	0	0	7	5
21	405	405	17	0	0	7	5
22	404	404	17	0	0	7	5
23	407	407	17	0	0	7	5
24	406	406	17	0	0	7	5
25	387	387	16	0	0	7	5
26	391	391	16	0	0	7	5
27	378	378	15	0	0	6	5
28	379	379	15	0	0	6	5
29	409	409	17	0	0	7	5
30	415	415	17	0	0	7	5
31	410	410	17	0	0	7	5
Total	**13131**	**13131**	**542**	**0**	**0**	**233**	**150**

Daily Simulation Results for System 1 (VAV)

Daily Air System Simulation Results for July (Table 2) :

Day	Electric Equipment (kWh)
1	2
2	2
3	2
4	2
5	2
6	2
7	2
8	2
9	2
10	2
11	2
12	2
13	2
14	2
15	2
16	2
17	2
18	2
19	2
20	2
21	2
22	2
23	2
24	2
25	2
26	2
27	2
28	2
29	2
30	2
31	2
Total	**68**

Zone Temperature Report for System 1 (VAV)

Project Name: HAP Original
Prepared by: Kamil

06/22/2023
12:29PM

1. Zone Temperature Statistics

Zone Name	Occ Max Zone Temp (°F)	Occ Hours More Than 5.0 °F Above Throt. Range	Occ Hours 1.0 to 5.0 °F Above Throt. Range	Occ Cooling Setpoint plus Throt. Range (°F)	Occ Hours Within Throt. Range or Dead-band	Occ Heating Setpoint minus Throt. Range (°F)	Occ Hours 1.0 to 5.0 °F Below Throt. Range	Occ Hours More Than 5.0 °F Below Throt. Range	Occ Min Zone Temp (°F)	Unocc Max Zone Temp (°F)	Unocc Cooling Setpoint plus Throt. Range (°F)	Unocc Heating Setpoint minus Throt. Range (°F)	Unocc Min Zone Temp (°F)
Zone 1	76.1	0	0	76.5	6600	68.5	0	0	69.8	95.6	81.5	63.5	71.8
Zone 2	76.3	0	0	76.5	6600	68.5	0	0	73.9	89.2	81.5	63.5	77.2
Zone 3	76.3	0	0	76.5	6600	68.5	0	0	69.8	90.0	81.5	63.5	72.4

Note: For any occupied hours in which cooling is unavailable or scheduled off, zone temperature out of range statistics are not reported.
Note: For any occupied hours in which heating is unavailable or scheduled off, zone temperature out of range statistics are not reported.

Annual Cost Summary

Table 1. Annual Costs

Component	Sample Building ($)
Air System Fans	237
Cooling	503
Heating	0
Pumps	0
Heat Rejection Fans	0
HVAC Sub-Total	**740**
Lights	204
Electric Equipment	93
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**297**
Grand Total	**1,038**

Table 2. Annual Cost per Unit Floor Area

Component	Sample Building ($/ft²)
Air System Fans	0.522
Cooling	1.104
Heating	0.000
Pumps	0.000
Heat Rejection Fans	0.000
HVAC Sub-Total	**1.627**
Lights	0.449
Electric Equipment	0.205
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**0.654**
Grand Total	**2.280**
Gross Floor Area (ft²)	455.0
Conditioned Floor Area (ft²)	455.0

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

Table 3. Component Cost as a Percentage of Total Cost

Component	Sample Building (%)
Air System Fans	22.9
Cooling	48.4
Heating	0.0
Pumps	0.0
Heat Rejection Fans	0.0
HVAC Sub-Total	**71.3**
Lights	19.7
Electric Equipment	9.0
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	**28.7**
Grand Total	**100.0**

Annual Energy and Emissions Summary

Table 1. Annual Costs

Component	Sample Building ($)
HVAC Components	
Electric	740
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**740**
Non-HVAC Components	
Electric	297
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**297**
Grand Total	**1,038**

Table 2. Annual Energy Consumption

Component	Sample Building
HVAC Components	
Electric (kWh)	6,380
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	2,564
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	8,944
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Table 3. Annual Emissions

Component	Sample Building
CO2 Equivalent (lb)	0

Table 4. Annual Cost per Unit Floor Area

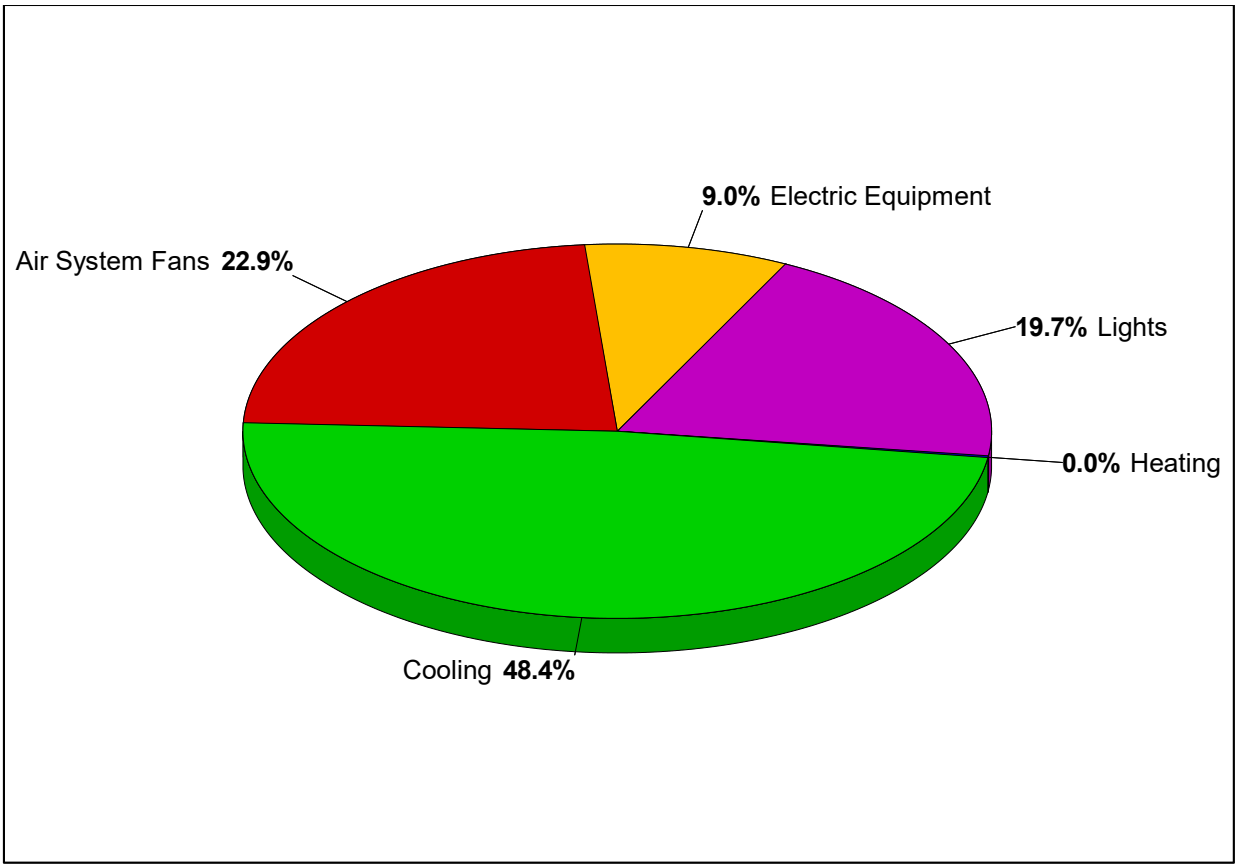
Component	Sample Building ($/ft²)
HVAC Components	
Electric	1.627
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	**1.627**
Non-HVAC Components	
Electric	0.654
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	**0.654**
Grand Total	**2.280**
Gross Floor Area (ft²)	455.0
Conditioned Floor Area (ft²)	455.0

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

Table 5. Component Cost as a Percentage of Total Cost

Component	Sample Building (%)
HVAC Components	
Electric	71.3
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	**71.3**
Non-HVAC Components	
Electric	28.7
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	**28.7**
Grand Total	**100.0**

Annual Component Costs - Sample Building



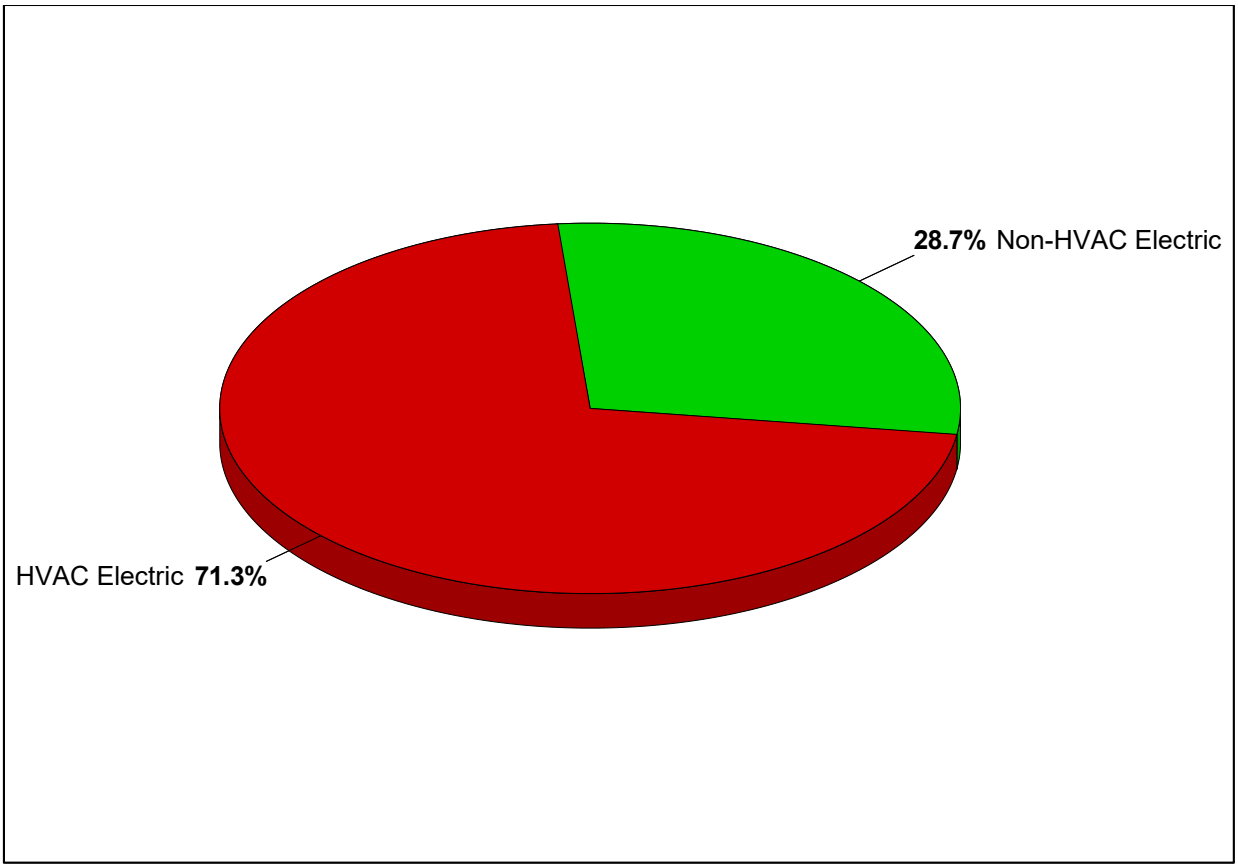
1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	237	0.522	22.9
Cooling	503	1.104	48.4
Heating	0	0.000	0.0
Pumps	0	0.000	0.0
Heat Rejection Fans	0	0.000	0.0
HVAC Sub-Total	**740**	**1.627**	**71.3**
Lights	204	0.449	19.7
Electric Equipment	93	0.205	9.0
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**297**	**0.654**	**28.7**
Grand Total	**1,038**	**2.280**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **455.0** ft²
Conditioned Floor Area ..... **455.0** ft²

Annual Energy Costs - Sample Building



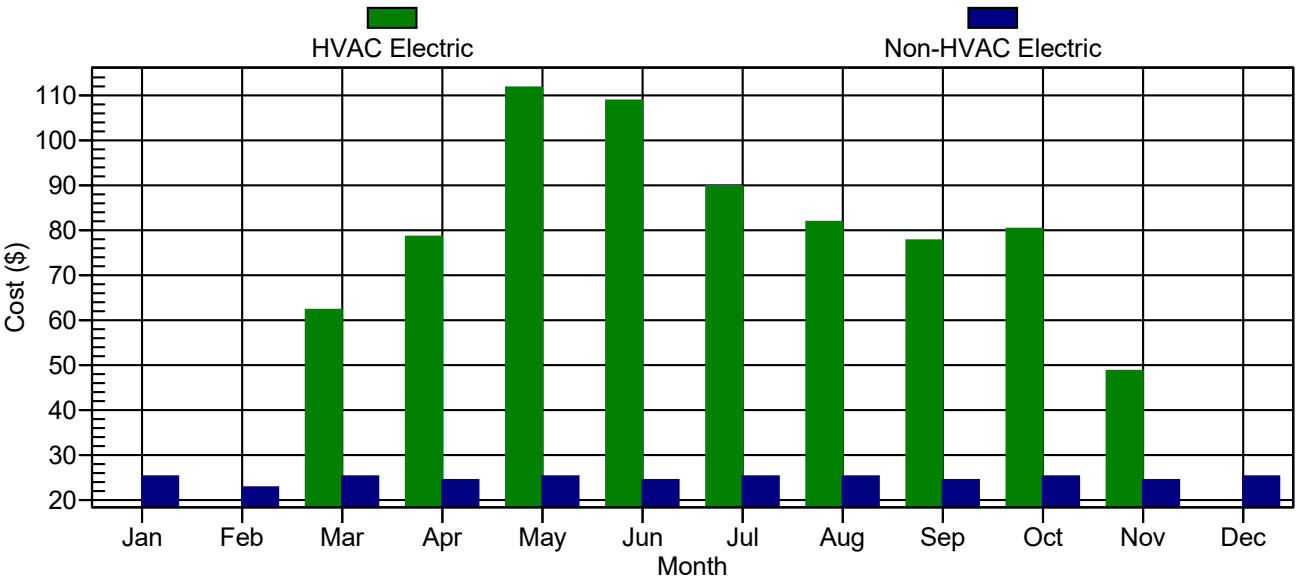
1. Annual Costs

Component	Annual Cost ($/yr)	($/ft²)	Percent of Total (%)
HVAC Components			
Electric	740	1.627	71.3
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	**740**	**1.627**	**71.3**
Non-HVAC Components			
Electric	297	0.654	28.7
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	**297**	**0.654**	**28.7**
Grand Total	**1,038**	**2.280**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **455.0** ft²
Conditioned Floor Area ..... **455.0** ft²

Monthly Energy Costs - Sample Building



1. HVAC Costs

Month	Electric ($)	Natural Gas ($)	Fuel Oil ($)	Propane ($)	Remote Hot Water ($)	Remote Steam ($)	Remote Chilled Water ($)
January	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0
March	62	0	0	0	0	0	0
April	79	0	0	0	0	0	0
May	112	0	0	0	0	0	0
June	109	0	0	0	0	0	0
July	90	0	0	0	0	0	0
August	82	0	0	0	0	0	0
September	78	0	0	0	0	0	0
October	80	0	0	0	0	0	0
November	49	0	0	0	0	0	0
December	0	0	0	0	0	0	0
Total	**740**	**0**	**0**	**0**	**0**	**0**	**0**

2. Non-HVAC Costs

Month	Electric ($)	Natural Gas ($)	Fuel Oil ($)	Propane ($)	Remote Hot Water ($)	Remote Steam ($)
January	25	0	0	0	0	0
February	23	0	0	0	0	0
March	25	0	0	0	0	0
April	24	0	0	0	0	0
May	25	0	0	0	0	0
June	24	0	0	0	0	0
July	25	0	0	0	0	0
August	25	0	0	0	0	0
September	24	0	0	0	0	0
October	25	0	0	0	0	0
November	24	0	0	0	0	0
December	25	0	0	0	0	0
Total	**297**	**0**	**0**	**0**	**0**	**0**

Bedroom 1

1. General Details:

Floor Area	**95.9**	ft²
Avg. Ceiling Height	**8.8**	ft
Building Weight	**70.0**	lb/ft²

1.1. OA Ventilation Requirements:

Space Usage	**HOTEL: Bedroom/living room**	
OA Requirement 1	**5.0**	CFM/person
OA Requirement 2	**0.06**	CFM/ft²
Space Usage Defaults	**ASHRAE Standard 62.1-2010**	

2. Internals:

2.1. Overhead Lighting:

Fixture Type	**Free Hanging**	
Wattage	**57.0**	Watts
Ballast Multiplier	**1.10**	
Schedule	**BD1 Light Schedule**	

2.2. Task Lighting:

Wattage	**0.00**	W/ft²
Schedule	**None**	

2.3. Electrical Equipment:

Wattage	**50.0**	Watts
Schedule	**BD1 Fan Schedule**	

2.4. People:

Occupancy	**2.0**	People
Activity Level	**Seated at Rest**	
Sensible	**230.0**	BTU/hr/person
Latent	**120.0**	BTU/hr/person
Schedule	**BD1 People Schedule**	

2.5. Miscellaneous Loads:

Sensible	**0**	BTU/hr
Schedule	**None**	
Latent	**0**	BTU/hr
Schedule	**None**	

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	84.6	1	0	0

3.1. Construction Types for Exposure SW

Wall Type	**Wall**
1st Window Type	**BD1-Window (Without Coating and Roller Shades)**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	95.9	0	0

4.1. Construction Types for Exposure H

Roof Type	**Roof**

5. Infiltration:

Design Cooling	**0.50**	ACH
Design Heating	**0.50**	ACH
Energy Analysis	**0.50**	ACH

Infiltration occurs at all hours.

6. Floors:

Type	**Floor Above Unconditioned Space**	
Floor Area	**95.9**	ft²
Total Floor U-Value	**0.335**	BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.	**95.0**	°F
Ambient at Space Max Temp.	**100.0**	°F
Unconditioned Space Min Temp.	**81.0**	°F
Ambient at Space Min Temp.	**86.0**	°F

7. Partitions:

7.1. 1st Partition Details:

Partition Type	**Wall Partition**	
Area	**84.6**	ft²
U-Value	**0.402**	BTU/(hr·ft²·°F)
Uncondit. Space Max Temp	**95.0**	°F
Ambient at Space Max Temp	**100.0**	°F
Uncondit. Space Min Temp	**81.0**	°F
Ambient at Space Min Temp	**86.0**	°F

7.2. 2nd Partition Details:

(No partition data).

Space Input Data

Bedroom 2

1. General Details:
Floor Area ..... **153.1** ft²
Avg. Ceiling Height ..... **8.8** ft
Building Weight ..... **70.0** lb/ft²

1.1. OA Ventilation Requirements:
Space Usage ..... **HOTEL: Bedroom/living room**
OA Requirement 1 ..... **5.0** CFM/person
OA Requirement 2 ..... **0.06** CFM/ft²
Space Usage Defaults .. **ASHRAE Standard 62.1-2010**

2. Internals:
2.1. Overhead Lighting:
Fixture Type ..... **Recessed (Unvented)**
Wattage ..... **169.0** Watts
Ballast Multiplier **1.10**
Schedule ..... **BD2 Light Schedule**

2.2. Task Lighting:
Wattage ..... **0.00** W/ft²
Schedule ..... **None**

2.3. Electrical Equipment:
Wattage ..... **50.0** Watts
Schedule ..... **BD2 Fan Schedule**

2.4. People:
Occupancy ..... **3.0** People
Activity Level ..... **Seated at Rest**
Sensible ..... **230.0** BTU/hr/person
Latent ..... **120.0** BTU/hr/person
Schedule ..... **BD2 People Schedule**

2.5. Miscellaneous Loads:
Sensible ..... **0** BTU/hr
Schedule ..... **None**
Latent ..... **0** BTU/hr
Schedule ..... **None**

3. Walls, Windows, Doors:
(No Wall, Window, Door data).

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	153.1	0	0

4.1. Construction Types for Exposure H
Roof Type ..... **Roof**

5. Infiltration:
Design Cooling ..... **0.50** ACH
Design Heating ..... **0.50** ACH
Energy Analysis ..... **0.50** ACH
Infiltration occurs at all hours.

6. Floors:
Type ..... **Floor Above Unconditioned Space**
Floor Area ..... **153.1** ft²
Total Floor U-Value ..... **0.335** BTU/(hr·ft²·°F)
Unconditioned Space Max Temp. ..... **95.0** °F
Ambient at Space Max Temp. ..... **100.0** °F
Unconditioned Space Min Temp. ..... **81.0** °F
Ambient at Space Min Temp. ..... **86.0** °F

7. Partitions:
7.1. 1st Partition Details:
Partition Type ..... **Wall Partition**
Area ..... **253.0** ft²
U-Value ..... **0.402** BTU/(hr·ft²·°F)
Uncondit. Space Max Temp ..... **95.0** °F
Ambient at Space Max Temp ..... **100.0** °F
Uncondit. Space Min Temp ..... **81.0** °F
Ambient at Space Min Temp ..... **86.0** °F

7.2. 2nd Partition Details:
(No partition data).

Kitchen

1. General Details:

Floor Area	**40.3**	ft²
Avg. Ceiling Height	**8.8**	ft
Building Weight	**70.0**	lb/ft²

1.1. OA Ventilation Requirements:

Space Usage	**FOOD SERVICE: Kitchen (cooking)**	
OA Requirement 1	**7.5**	CFM/person
OA Requirement 2	**0.12**	CFM/ft²
Space Usage Defaults	**ASHRAE Standard 62.1-2010**	

2. Internals:

2.1. Overhead Lighting:

Fixture Type	**Free Hanging**	
Wattage	**31.0**	Watts
Ballast Multiplier	**1.10**	
Schedule	**Kitchen Light Schedule**	

2.2. Task Lighting:

Wattage	**0.00**	W/ft²
Schedule	**None**	

2.3. Electrical Equipment:

Wattage	**0.0**	Watts
Schedule	**None**	

2.4. People:

Occupancy	**2.0**	People
Activity Level	**Sedentary Work**	
Sensible	**280.0**	BTU/hr/person
Latent	**270.0**	BTU/hr/person
Schedule	**Kitchen People Schedule**	

2.5. Miscellaneous Loads:

Sensible	**0**	BTU/hr
Schedule	**None**	
Latent	**0**	BTU/hr
Schedule	**None**	

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	50.3	1	0	0
NW	30.6	0	0	0

3.1. Construction Types for Exposure SW

Wall Type	**Wall**
1st Window Type	**KC-Window (With Coating and No Blinds)**

3.2. Construction Types for Exposure NW

Wall Type	**Wall**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	40.3	0	0

4.1. Construction Types for Exposure H

Roof Type	**Roof**

5. Infiltration:

Design Cooling	**0.50**	ACH
Design Heating	**0.50**	ACH
Energy Analysis	**0.50**	ACH

Infiltration occurs at all hours.

6. Floors:

Type	**Floor Above Unconditioned Space**	
Floor Area	**40.3**	ft²
Total Floor U-Value	**0.335**	BTU/(hr·ft²·°F)
Unconditioned Space Max Temp.	**95.0**	°F
Ambient at Space Max Temp.	**100.0**	°F
Unconditioned Space Min Temp.	**81.0**	°F
Ambient at Space Min Temp.	**86.0**	°F

7. Partitions:

7.1. 1st Partition Details:

Partition Type	**Wall Partition**	
Area	**30.6**	ft²
U-Value	**0.402**	BTU/(hr·ft²·°F)
Uncondit. Space Max Temp	**95.0**	°F
Ambient at Space Max Temp	**100.0**	°F
Uncondit. Space Min Temp	**81.0**	°F
Ambient at Space Min Temp	**86.0**	°F

7.2. 2nd Partition Details: **(No partition data).**

Lounge

1. General Details:
Floor Area ..... **165.7** ft²
Avg. Ceiling Height ..... **8.8** ft
Building Weight ..... **70.0** lb/ft²

1.1. OA Ventilation Requirements:
Space Usage ..... **HOTEL: Bedroom/living room**
OA Requirement 1 ..... **5.0** CFM/person
OA Requirement 2 ..... **0.06** CFM/ft²
Space Usage Defaults .. **ASHRAE Standard 62.1-2010**

2. Internals:
2.1. Overhead Lighting:
Fixture Type ..... **Free Hanging**
Wattage ..... **57.0** Watts
Ballast Multiplier **1.10**
Schedule ..... **Lounge Light Schedule**

2.2. Task Lighting:
Wattage ..... **0.00** W/ft²
Schedule ..... **None**

2.3. Electrical Equipment:
Wattage ..... **50.0** Watts
Schedule ..... **Lounge Fan Schedule**

2.4. People:
Occupancy ..... **5.0** People
Activity Level ..... **Seated at Rest**
Sensible ..... **230.0** BTU/hr/person
Latent ..... **120.0** BTU/hr/person
Schedule ..... **Lounge People Schedule**

2.5. Miscellaneous Loads:
Sensible ..... **0** BTU/hr
Schedule ..... **None**
Latent ..... **0** BTU/hr
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (ft²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
NE	81.7	1	0	0

3.1. Construction Types for Exposure NE
Wall Type ..... **Wall**
1st Window Type . **L-Window (With Coating and Venetian Blinds)**

4. Roofs, Skylights:

Exp.	Roof Gross Area (ft²)	Roof Slope (deg.)	Skylight Qty.
H	165.7	0	0

4.1. Construction Types for Exposure H
Roof Type ..... **Roof**

5. Infiltration:
Design Cooling ..... **0.50** ACH
Design Heating ..... **0.50** ACH
Energy Analysis ..... **0.50** ACH
Infiltration occurs at all hours.

6. Floors:
Type ..... **Floor Above Unconditioned Space**
Floor Area ..... **165.7** ft²
Total Floor U-Value ..... **0.335** BTU/(hr·ft²·°F)
Unconditioned Space Max Temp. ..... **95.0** °F
Ambient at Space Max Temp. ..... **100.0** °F
Unconditioned Space Min Temp. ..... **81.0** °F
Ambient at Space Min Temp. ..... **86.0** °F

7. Partitions:
7.1. 1st Partition Details:
Partition Type ..... **Wall Partition**
Area ..... **222.4** ft²
U-Value ..... **0.402** BTU/(hr·ft²·°F)
Uncondit. Space Max Temp ..... **95.0** °F
Ambient at Space Max Temp ..... **100.0** °F
Uncondit. Space Min Temp ..... **81.0** °F
Ambient at Space Min Temp ..... **86.0** °F

7.2. 2nd Partition Details:
(No partition data).

Air System Sizing Summary for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:25PM

Air System Information

Air System Name	**System 1 (VAV)**		Number of zones	**3**	
Equipment Class	**PKG ROOF**		Floor Area	**455.0**	ft²
Air System Type	**VAV**		Location	**Karachi, Pakistan**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**		Zone CFM Sizing	**Peak zone sensible load**	
Sizing Data	**Calculated**		Space CFM Sizing	**Individual peak space loads**	

Central Cooling Coil Sizing Data

Total coil load	**3.1**	Tons	Load occurs at	**Aug 1600**	
Total coil load	**36.7**	MBH	OA DB / WB	**99.6 / 81.9**	°F
Sensible coil load	**28.7**	MBH	Entering DB / WB	**78.5 / 63.7**	°F
Coil CFM at Aug 1600	**994**	CFM	Leaving DB / WB	**51.7 / 50.5**	°F
Max block CFM at Aug 1600	**1115**	CFM	Coil ADP	**48.8**	°F
Sum of peak zone CFM	**1132**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.781**		Resulting RH	**42**	%
CFM/Ton	**324.8**		Design supply temp.	**55.0**	°F
ft²/Ton	**148.7**		Zone T-stat Check	**3 of 3**	OK
BTU/(hr·ft²)	**80.7**		Max zone temperature deviation	**0.0**	°F
Water flow @ 10.0 °F rise	**N/A**				

Supply Fan Sizing Data

Actual max CFM at Aug 1600	**1115**	CFM	Fan motor BHP	**1.72**	BHP
Standard CFM	**1114**	CFM	Fan motor kW	**1.36**	kW
Actual max CFM/ft²	**2.45**	CFM/ft²	Fan static	**5.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**106**	CFM	CFM/person	**10.49**	CFM/person
CFM/ft²	**0.23**	CFM/ft²			

Zone Sizing Summary for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:25PM

Air System Information

Air System Name ..... **System 1 (VAV)**
Equipment Class ..... **PKG ROOF**
Air System Type ..... **VAV**

Number of zones **3**
Floor Area ..... **455.0** ft²
Location ..... **Karachi, Pakistan**

Sizing Calculation Information

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

Zone CFM Sizing ..... **Peak zone sensible load**
Space CFM Sizing ..... **Individual peak space loads**

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/ft²	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 20.0 °F	Zone Htg Unit Coil Load (MBH)	Zone Htg Unit Water gpm @ 20.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	323	67	3.37	2.9	-	0.0	-	0
Zone 2	288	49	1.88	2.1	-	0.0	-	0
Zone 3	521	132	2.53	5.7	-	0.0	-	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)
Zone 1	7.0	Oct 1500	1.8	95.9
Zone 2	6.2	Jul 1700	1.3	153.1
Zone 3	11.2	Jul 1700	3.6	206.0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Bedroom 1	1	7.0	Oct 1500	323	1.8	95.9	3.37
Zone 2							
Bedroom 2	1	6.2	Jul 1700	288	1.3	153.1	1.88
Zone 3							
Kitchen	1	3.2	Aug 1700	146	1.2	40.3	3.63
Lounge	1	8.2	Jul 1600	379	2.4	165.7	2.29

Ventilation Sizing Summary for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:25PM

1. Summary

Ventilation Sizing Method ..... **ASHRAE Std 62.1-2010**
Design Condition ..... **Minimum flow (heating)**
Occupant Diversity (D) **1.000**
Uncorrected Outdoor Air Intake (Vou) ..... **84** CFM
System Ventilation Efficiency (Ev) **0.795**
Outdoor Air Intake (Vot) ..... **106** CFM

2. Space Ventilation Analysis

Zone Name / Space Name	Mult.	Minimum Supply Air (CFM) (Vpz)	Space Floor Area (ft^2) (Az)	Area Outdoor Air Rate (CFM/ft^2) (Ra)	Time Averaged Occupancy (Occupants) (Pz)	People Outdoor Air Rate (CFM/person) (Rp)	Air Distribution Effectiveness (Ez)	Space Outdoor Air (CFM) (Voz)	Breathing Zone Outdoor Air (CFM) (Vbz)	Space Ventilation Efficiency (Evz)
Zone 1										
Bedroom 1	1	20	95.9	0.06	2.0	5.00	0.8	**20**	*16*	0.795
Zone 2										
Bedroom 2	1	30	153.1	0.06	3.0	5.00	0.8	**30**	*24*	0.795
Zone 3										
Kitchen	1	21	40.3	0.12	1.6	7.50	0.8	**21**	*17*	0.795
Lounge	1	35	165.7	0.06	3.5	5.00	0.8	**34**	*27*	0.813
Totals (incl. Space Multipliers)		**106**							**84**	**0.795**

Air System Design Load Summary for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:25PM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 99.6 °F / 81.9 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	58 ft²	3080	-	58 ft²	-	-
Wall Transmission	189 ft²	1951	-	189 ft²	1600	-
Roof Transmission	455 ft²	7999	-	455 ft²	3205	-
Window Transmission	58 ft²	1219	-	58 ft²	1145	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	455 ft²	2648	-	455 ft²	0	-
Partitions	591 ft²	4124	-	591 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	73 W	254	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	75 W	242	-	0	0	-
People	7	1661	1092	0	0	0
Infiltration	-	885	1810	-	756	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**24065**	**2902**	**-**	**6707**	**0**
Zone Conditioning	-	22807	2902	-	5772	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	994 CFM	0	-	249 CFM	0	-
Ventilation Load	94 CFM	2379	5124	194 CFM	4131	0
Supply Fan Load	994 CFM	3515	-	249 CFM	-461	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**28701**	**8026**	**-**	**9442**	**0**
Central Cooling Coil	-	28702	8028	-	0	0
Terminal Reheat Coils	-	0	-	-	9442	-
>> Total Conditioning	**-**	**28702**	**8028**	**-**	**9442**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Oct 1500 COOLING OA DB / WB 96.0 °F / 80.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	25 ft²	3344	-	25 ft²	-	-
Wall Transmission	60 ft²	550	-	60 ft²	505	-
Roof Transmission	96 ft²	1257	-	96 ft²	676	-
Window Transmission	25 ft²	409	-	25 ft²	465	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	96 ft²	445	-	96 ft²	0	-
Partitions	85 ft²	471	-	85 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	6 W	24	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	25 W	80	-	0	0	-
People	1	239	96	0	0	0
Infiltration	-	159	338	-	159	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**6978**	**434**	**-**	**1805**	**0**

Zone 2	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 98.6 °F / 81.7 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft²	0	-	0 ft²	-	-
Wall Transmission	0 ft²	0	-	0 ft²	0	-
Roof Transmission	153 ft²	2855	-	153 ft²	1079	-
Window Transmission	0 ft²	0	-	0 ft²	0	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	153 ft²	864	-	153 ft²	0	-
Partitions	253 ft²	1714	-	253 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	19 W	74	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	25 W	81	-	0	0	-
People	1	348	144	0	0	0
Infiltration	-	286	607	-	255	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**6221**	**751**	**-**	**1333**	**0**

Zone Design Load Summary for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:25PM

Zone 3	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700			HEATING DATA AT DES HTG		
	COOLING OA DB / WB 98.6 °F / 81.7 °F			HEATING OA DB / WB 49.0 °F / 41.1 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	33 ft²	673	-	33 ft²	-	-
Wall Transmission	130 ft²	1438	-	130 ft²	1095	-
Roof Transmission	206 ft²	3841	-	206 ft²	1451	-
Window Transmission	33 ft²	707	-	33 ft²	680	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	206 ft²	1163	-	206 ft²	0	-
Partitions	253 ft²	1714	-	253 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	48 W	157	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	25 W	81	-	0	0	-
People	5	1085	852	0	0	0
Infiltration	-	385	817	-	342	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**11244**	**1669**	**-**	**3569**	**0**

ZONE: Zone 1
DESIGN MONTH: JULY

Hour	OA TEMP (°F)	ZONE TEMP (°F)	RH (%)	ZONE AIRFLOW (CFM)	ZONE SENSIBLE LOAD (BTU/hr)	ZONE COND (BTU/hr)	TERMINAL COOLING COIL (BTU/hr)	TERMINAL HEATING COIL (BTU/hr)	ZONE HEATING UNIT (BTU/hr)
0000	88.5	75.5	46	151.8	3387.6	3355.7	0.0	0.0	0.0
0100	87.8	75.4	46	142.9	3172.3	3151.2	0.0	0.0	0.0
0200	87.1	75.4	47	135.2	2987.4	2974.5	0.0	0.0	0.0
0300	86.6	75.3	47	128.4	2825.3	2818.8	0.0	0.0	0.0
0400	86.1	75.3	48	122.4	2684.3	2682.7	0.0	0.0	0.0
0500	86.0	75.3	48	117.6	2572.9	2573.9	0.0	0.0	0.0
0600	86.3	75.3	48	117.2	2569.0	2564.8	0.0	0.0	0.0
0700	87.0	75.3	49	122.2	2697.3	2679.0	0.0	0.0	0.0
0800	88.2	75.3	48	125.7	2787.1	2758.9	0.0	0.0	0.0
0900	90.1	75.4	47	134.9	3015.6	2967.9	0.0	0.0	0.0
1000	92.2	75.4	47	147.1	3318.7	3247.6	0.0	0.0	0.0
1100	94.5	75.5	46	162.5	3699.9	3601.2	0.0	0.0	0.0
1200	96.8	75.6	45	179.1	4116.1	3989.1	0.0	0.0	0.0
1300	98.5	75.8	44	206.4	4806.1	4632.1	0.0	0.0	0.0
1400	99.6	76.0	43	236.9	5588.7	5363.9	0.0	0.0	0.0
1500	100.0	76.1	42	259.1	6159.5	5902.6	0.0	0.0	0.0
1600	99.6	76.2	42	268.0	6382.0	6120.2	0.0	0.0	0.0
1700	98.6	76.1	42	261.2	6190.6	5953.8	0.0	0.0	0.0
1800	97.1	76.0	43	235.1	5495.3	5318.1	0.0	0.0	0.0
1900	95.2	75.8	43	205.1	4716.6	4600.2	0.0	0.0	0.0
2000	93.4	75.7	44	194.9	4458.8	4360.1	0.0	0.0	0.0
2100	91.9	75.7	45	183.4	4167.2	4088.5	0.0	0.0	0.0
2200	90.5	75.6	45	171.6	3873.9	3814.0	0.0	0.0	0.0
2300	89.4	75.5	46	163.5	3674.6	3625.6	0.0	0.0	0.0

ZONE: Zone 2
DESIGN MONTH: JULY

Hour	OA TEMP (°F)	ZONE TEMP (°F)	RH (%)	ZONE AIRFLOW (CFM)	ZONE SENSIBLE LOAD (BTU/hr)	ZONE COND (BTU/hr)	TERMINAL COOLING COIL (BTU/hr)	TERMINAL HEATING COIL (BTU/hr)	ZONE HEATING UNIT (BTU/hr)
0000	88.5	75.8	46	173.9	3996.4	3897.0	0.0	0.0	0.0
0100	87.8	75.7	46	162.7	3707.7	3633.4	0.0	0.0	0.0
0200	87.1	75.6	47	153.4	3471.9	3415.8	0.0	0.0	0.0
0300	86.6	75.6	47	145.3	3269.5	3227.2	0.0	0.0	0.0
0400	86.1	75.5	48	138.3	3097.9	3065.6	0.0	0.0	0.0
0500	86.0	75.5	48	133.0	2971.8	2944.1	0.0	0.0	0.0
0600	86.3	75.5	48	131.5	2941.8	2908.0	0.0	0.0	0.0
0700	87.0	75.5	49	131.3	2946.3	2903.5	0.0	0.0	0.0
0800	88.2	75.5	48	130.7	2938.9	2889.7	0.0	0.0	0.0
0900	90.1	75.5	47	140.6	3204.2	3117.6	0.0	0.0	0.0
1000	92.2	75.6	47	155.8	3608.9	3472.3	0.0	0.0	0.0
1100	94.5	75.8	46	175.7	4136.0	3938.7	0.0	0.0	0.0
1200	96.8	75.9	45	197.2	4708.0	4449.1	0.0	0.0	0.0
1300	98.5	76.0	44	217.2	5242.7	4930.3	0.0	0.0	0.0
1400	99.6	76.1	43	234.4	5704.3	5349.9	0.0	0.0	0.0
1500	100.0	76.2	42	247.1	6042.8	5662.4	0.0	0.0	0.0
1600	99.6	76.3	42	253.7	6212.1	5826.1	0.0	0.0	0.0
1700	98.6	76.3	42	254.6	6220.9	5847.1	0.0	0.0	0.0
1800	97.1	76.3	43	254.1	6193.3	5834.1	0.0	0.0	0.0
1900	95.2	76.2	43	243.4	5884.5	5570.8	0.0	0.0	0.0
2000	93.4	76.1	44	228.9	5476.6	5215.7	0.0	0.0	0.0
2100	91.9	76.0	45	213.6	5053.7	4843.4	0.0	0.0	0.0
2200	90.5	75.9	45	198.6	4647.6	4482.6	0.0	0.0	0.0
2300	89.4	75.9	46	190.0	4420.2	4276.9	0.0	0.0	0.0

ZONE: Zone 3
DESIGN MONTH: JULY

Hour	OA TEMP (°F)	ZONE TEMP (°F)	RH (%)	ZONE AIRFLOW (CFM)	ZONE SENSIBLE LOAD (BTU/hr)	ZONE COND (BTU/hr)	TERMINAL COOLING COIL (BTU/hr)	TERMINAL HEATING COIL (BTU/hr)	ZONE HEATING UNIT (BTU/hr)
0000	88.5	75.6	46	307.0	6962.6	6843.9	0.0	0.0	0.0
0100	87.8	75.6	46	288.5	6487.3	6409.3	0.0	0.0	0.0
0200	87.1	75.5	47	271.2	6045.8	6005.4	0.0	0.0	0.0
0300	86.6	75.5	47	255.8	5656.4	5647.3	0.0	0.0	0.0
0400	86.1	75.4	48	242.1	5315.6	5332.1	0.0	0.0	0.0
0500	86.0	75.4	48	231.0	5042.6	5077.1	0.0	0.0	0.0
0600	86.3	75.4	48	242.1	5340.1	5332.8	0.0	0.0	0.0
0700	87.0	75.6	49	291.1	6618.0	6469.2	0.0	0.0	0.0
0800	88.2	75.6	48	306.0	7009.8	6820.1	0.0	0.0	0.0
0900	90.1	75.7	47	316.6	7290.3	7070.3	0.0	0.0	0.0
1000	92.2	75.7	47	328.9	7614.4	7360.3	0.0	0.0	0.0
1100	94.5	75.8	46	346.4	8078.4	7776.7	0.0	0.0	0.0
1200	96.8	75.9	45	373.6	8805.5	8430.6	0.0	0.0	0.0
1300	98.5	76.0	44	403.7	9616.9	9163.0	0.0	0.0	0.0
1400	99.6	76.1	43	430.4	10339.2	9818.2	0.0	0.0	0.0
1500	100.0	76.2	42	450.8	10891.6	10323.1	0.0	0.0	0.0
1600	99.6	76.3	42	462.2	11196.3	10607.0	0.0	0.0	0.0
1700	98.6	76.3	42	464.3	11243.7	10660.3	0.0	0.0	0.0
1800	97.1	76.2	43	454.9	10969.8	10424.8	0.0	0.0	0.0
1900	95.2	76.2	43	437.6	10483.2	9996.5	0.0	0.0	0.0
2000	93.4	76.1	44	417.7	9929.0	9504.9	0.0	0.0	0.0
2100	91.9	76.0	45	395.3	9314.5	8956.9	0.0	0.0	0.0
2200	90.5	75.9	45	372.6	8700.5	8407.0	0.0	0.0	0.0
2300	89.4	75.8	46	346.2	7994.3	7772.4	0.0	0.0	0.0

August DESIGN COOLING DAY, 1600

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	99.6	0.01952	94	400	2379	5124
Vent - Return Mixing	Outlet	78.5	0.00917	994	863	-	-
Central Cooling Coil	Outlet	51.7	0.00747	994	863	28702	8028
Supply Fan	Outlet	55.0	0.00747	994	863	3515	-
Cold Supply Duct	Outlet	55.0	0.00747	994	863	-	-
Zone Air	-	76.3	0.00808	994	911	22807	2902
Return Plenum	Outlet	76.3	0.00808	994	911	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.079 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4744.4 BTU/(hr-CFM)
Site Altitude = 13.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	6794	Cooling	6508	76.3	284	868	0	0
Zone 2	6155	Cooling	5772	76.3	252	877	0	0
Zone 3	11116	Cooling	10527	76.2	459	957	0	0

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

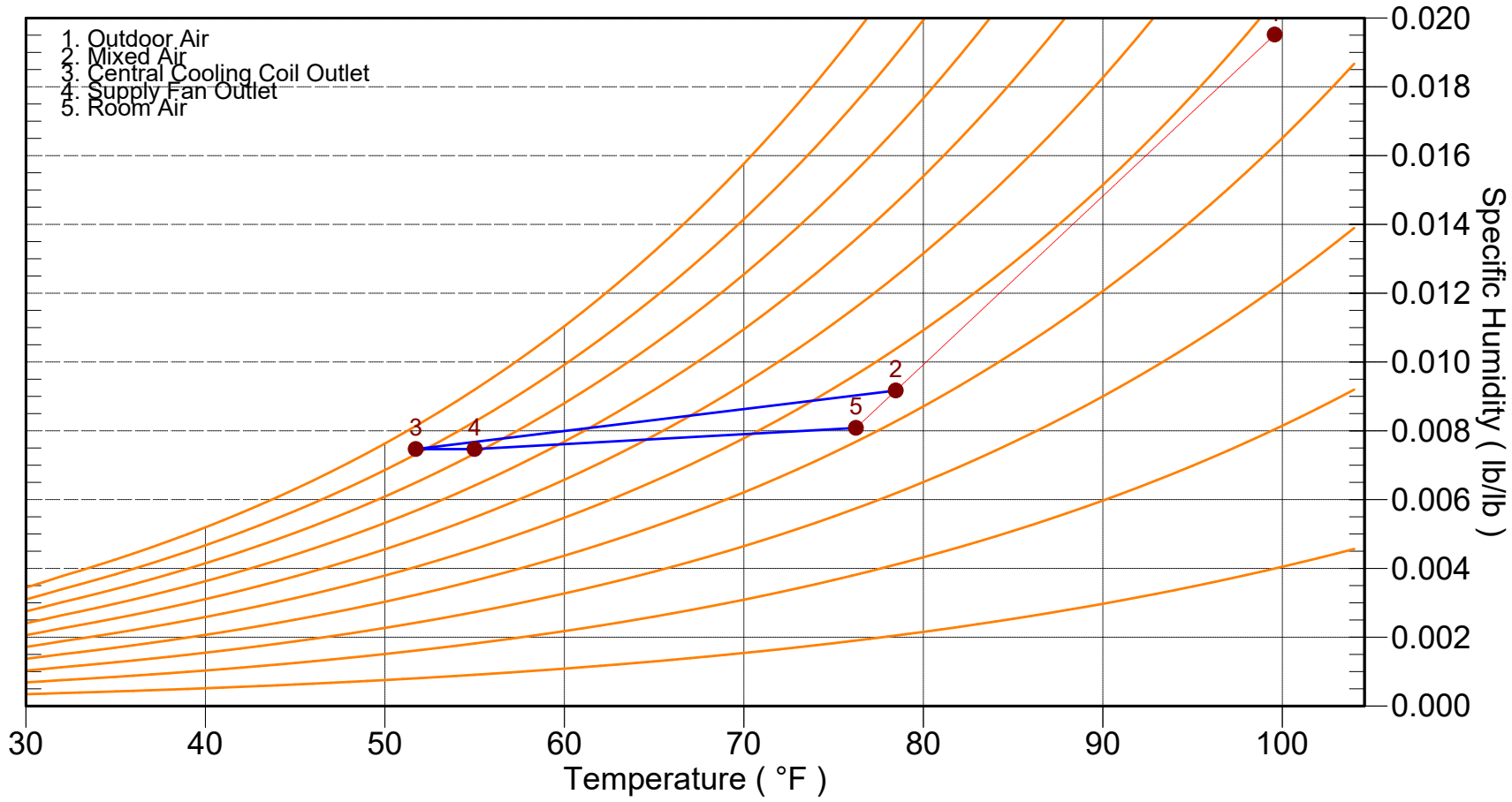
Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	49.0	0.00364	194	400	-4131	0
Vent - Return Mixing	Outlet	53.3	0.00364	249	401	-	-
Central Cooling Coil	Outlet	53.3	0.00364	249	401	0	0
Supply Fan	Outlet	55.0	0.00364	249	401	461	-
Cold Supply Duct	Outlet	55.0	0.00364	249	401	-	-
Zone Air	-	68.7	0.00364	249	404	-5772	0
Return Plenum	Outlet	68.7	0.00364	249	404	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.079 BTU/(hr-CFM-F)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4744.4 BTU/(hr-CFM)
Site Altitude = 13.0 ft

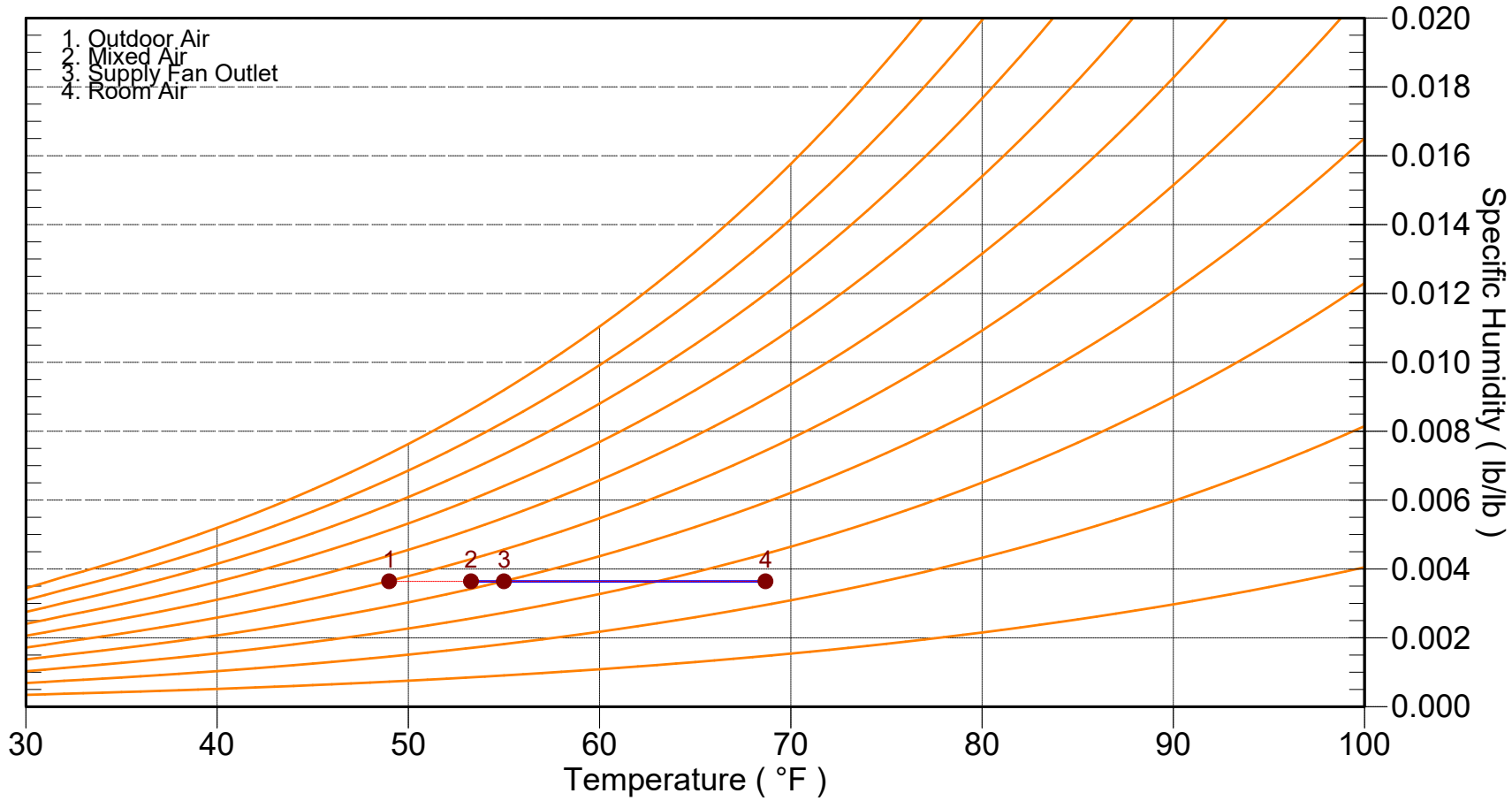
TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	-1805	Heating	-1601	68.7	67	404	2587	0
Zone 2	-1333	Heating	-1060	68.7	49	404	1793	0
Zone 3	-3569	Heating	-3112	68.7	132	404	5063	0

Location: Karachi, Pakistan
Altitude: 13.0 ft.
Data for: August DESIGN COOLING DAY, 1600



Location: Karachi, Pakistan
Altitude: 13.0 ft.
Data for: WINTER DESIGN HEATING



Monthly Simulation Results for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:26PM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)	Supply Fan (kWh)	Lighting (kWh)
January	0	0	0	0	0	0	60
February	0	0	0	0	0	0	54
March	8368	8368	334	0	0	175	60
April	10857	10857	440	0	0	206	58
May	14741	14741	630	0	0	300	60
June	14709	14705	630	0	0	277	58
July	12581	12581	524	0	0	219	60
August	11713	11713	479	0	0	195	60
September	11058	11058	449	0	0	191	58
October	10498	10498	438	0	0	222	60
November	6435	6435	254	6	2	141	58
December	0	0	0	0	0	0	60
Total	**100961**	**100957**	**4177**	**6**	**2**	**1927**	**705**

Air System Simulation Results (Table 2) :

Month	Electric Equipment (kWh)
January	39
February	35
March	39
April	38
May	39
June	38
July	39
August	39
September	38
October	39
November	38
December	39
Total	**460**

Daily Air System Simulation Results for July (Table 1) :

Day	Central Cooling Coil Load (kBTU)	Central Cooling Eqpt Load (kBTU)	Central Unit Clg Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)	Supply Fan (kWh)	Lighting (kWh)
1	430	430	18	0	0	7	2
2	389	389	16	0	0	6	2
3	402	402	17	0	0	7	2
4	423	423	18	0	0	7	2
5	452	452	19	0	0	8	2
6	468	468	20	0	0	9	2
7	468	468	20	0	0	9	2
8	473	473	20	0	0	9	2
9	469	469	20	0	0	9	2
10	433	433	18	0	0	8	2
11	393	393	16	0	0	7	2
12	370	370	15	0	0	6	2
13	381	381	16	0	0	6	2
14	406	406	17	0	0	7	2
15	428	428	18	0	0	8	2
16	399	399	16	0	0	7	2
17	393	393	16	0	0	7	2
18	428	428	18	0	0	8	2
19	398	398	16	0	0	7	2
20	379	379	16	0	0	6	2
21	387	387	16	0	0	7	2
22	386	386	16	0	0	7	2
23	390	390	16	0	0	7	2
24	388	388	16	0	0	7	2
25	369	369	15	0	0	6	2
26	373	373	15	0	0	6	2
27	360	360	15	0	0	6	2
28	361	361	15	0	0	6	2
29	391	391	16	0	0	7	2
30	397	397	16	0	0	7	2
31	393	393	16	0	0	7	2
Total	**12581**	**12581**	**524**	**0**	**0**	**219**	**60**

Daily Air System Simulation Results for July (Table 2) :

Day	Electric Equipment (kWh)
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1
16	1
17	1
18	1
19	1
20	1
21	1
22	1
23	1
24	1
25	1
26	1
27	1
28	1
29	1
30	1
31	1
Total	**39**

Zone Temperature Report for System 1 (VAV)

Project Name: HAP Modified
Prepared by: Kamil

06/22/2023
12:26PM

1. Zone Temperature Statistics

Zone Name	Occ Max Zone Temp (°F)	Occ Hours More Than 5.0 °F Above Throt. Range	Occ Hours 1.0 to 5.0 °F Above Throt. Range	Occ Cooling Setpoint plus Throt. Range (°F)	Occ Hours Within Throt. Range or Dead-band	Occ Heating Setpoint minus Throt. Range (°F)	Occ Hours 1.0 to 5.0 °F Below Throt. Range	Occ Hours More Than 5.0 °F Below Throt. Range	Occ Min Zone Temp (°F)	Unocc Max Zone Temp (°F)	Unocc Cooling Setpoint plus Throt. Range (°F)	Unocc Heating Setpoint minus Throt. Range (°F)	Unocc Min Zone Temp (°F)
Zone 1	76.1	0	0	76.5	6600	68.5	0	0	69.7	94.8	81.5	63.5	71.0
Zone 2	76.4	0	0	76.5	6600	68.5	0	0	73.0	87.7	81.5	63.5	76.1
Zone 3	76.3	0	0	76.5	6600	68.5	0	0	69.8	89.2	81.5	63.5	72.0

Note: For any occupied hours in which cooling is unavailable or scheduled off, zone temperature out of range statistics are not reported.
Note: For any occupied hours in which heating is unavailable or scheduled off, zone temperature out of range statistics are not reported.

Annual Cost Summary

HAP Modified
Kamil

06/22/2023
12:26PM

Table 1. Annual Costs

Component	Sample Building ($)
Air System Fans	224
Cooling	485
Heating	0
Pumps	0
Heat Rejection Fans	0
HVAC Sub-Total	**708**
Lights	82
Electric Equipment	53
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**135**
Grand Total	**843**

Table 2. Annual Cost per Unit Floor Area

Component	Sample Building ($/ft²)
Air System Fans	0.491
Cooling	1.065
Heating	0.001
Pumps	0.000
Heat Rejection Fans	0.000
HVAC Sub-Total	**1.557**
Lights	0.180
Electric Equipment	0.117
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**0.297**
Grand Total	**1.854**
Gross Floor Area (ft²)	455.0
Conditioned Floor Area (ft²)	455.0

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

Table 3. Component Cost as a Percentage of Total Cost

Component	Sample Building (%)
Air System Fans	26.5
Cooling	57.4
Heating	0.0
Pumps	0.0
Heat Rejection Fans	0.0
HVAC Sub-Total	**84.0**
Lights	9.7
Electric Equipment	6.3
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	**16.0**
Grand Total	**100.0**

Annual Energy and Emissions Summary

Table 1. Annual Costs

Component	Sample Building ($)
HVAC Components	
Electric	708
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	**708**
Non-HVAC Components	
Electric	135
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	**135**
Grand Total	**843**

Table 2. Annual Energy Consumption

Component	Sample Building
HVAC Components	
Electric (kWh)	6,106
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	1,165
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	7,271
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Annual Energy and Emissions Summary

Table 3. Annual Emissions

Component	Sample Building
CO2 Equivalent (lb)	0

Table 4. Annual Cost per Unit Floor Area

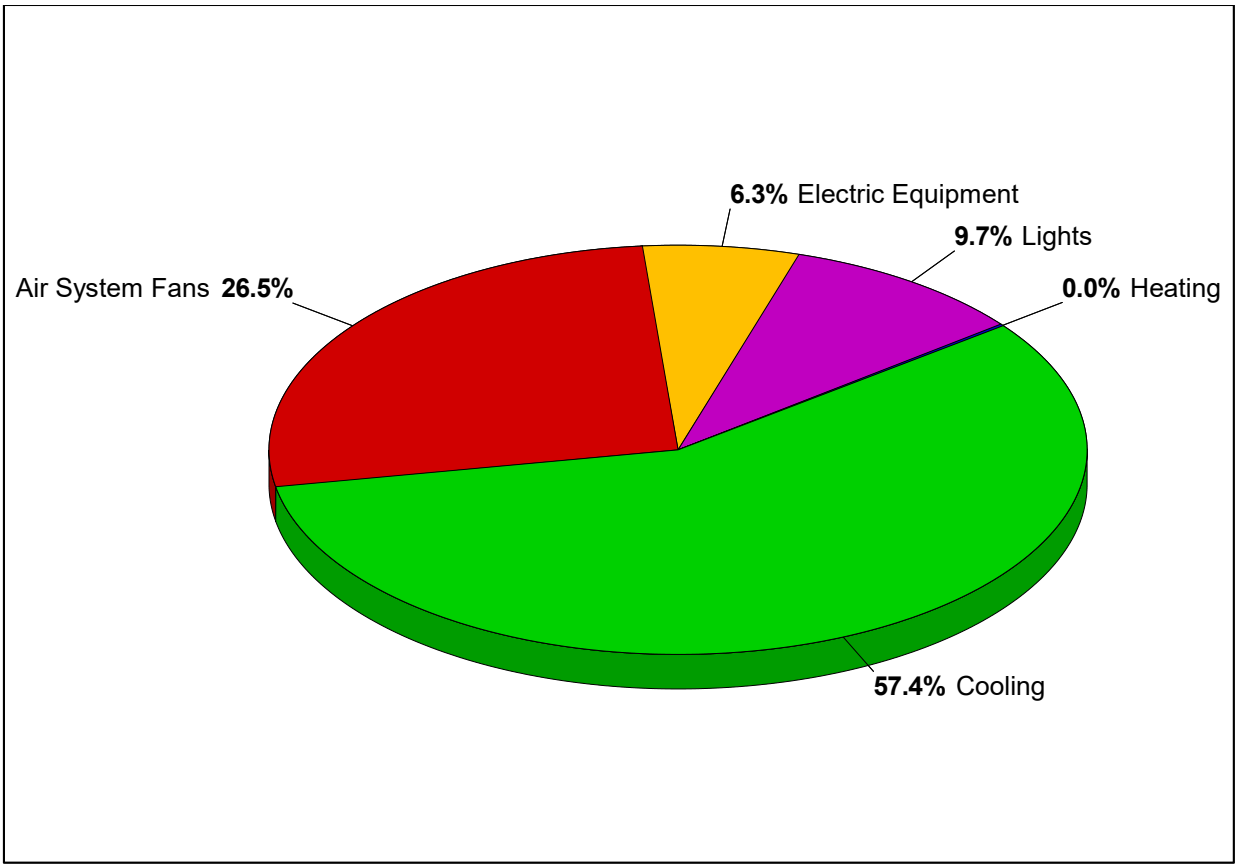
Component	Sample Building ($/ft²)
HVAC Components	
Electric	1.557
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	**1.557**
Non-HVAC Components	
Electric	0.297
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	**0.297**
Grand Total	**1.854**
Gross Floor Area (ft²)	455.0
Conditioned Floor Area (ft²)	455.0

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

Table 5. Component Cost as a Percentage of Total Cost

Component	Sample Building (%)
HVAC Components	
Electric	84.0
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	**84.0**
Non-HVAC Components	
Electric	16.0
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	**16.0**
Grand Total	**100.0**

Annual Component Costs - Sample Building



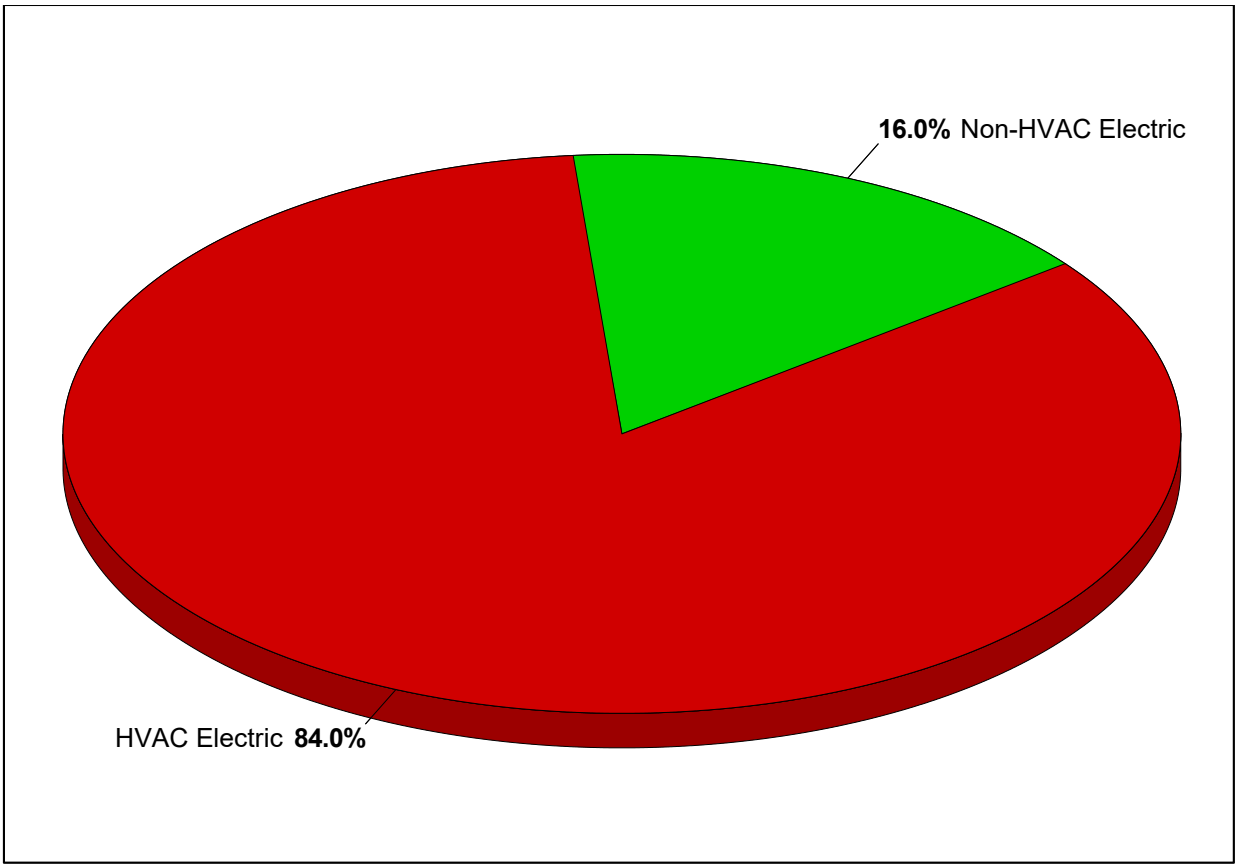
1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	224	0.491	26.5
Cooling	485	1.065	57.4
Heating	0	0.001	0.0
Pumps	0	0.000	0.0
Heat Rejection Fans	0	0.000	0.0
HVAC Sub-Total	**708**	**1.557**	**84.0**
Lights	82	0.180	9.7
Electric Equipment	53	0.117	6.3
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**135**	**0.297**	**16.0**
Grand Total	**843**	**1.854**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **455.0** ft²
Conditioned Floor Area ..... **455.0** ft²

Annual Energy Costs - Sample Building



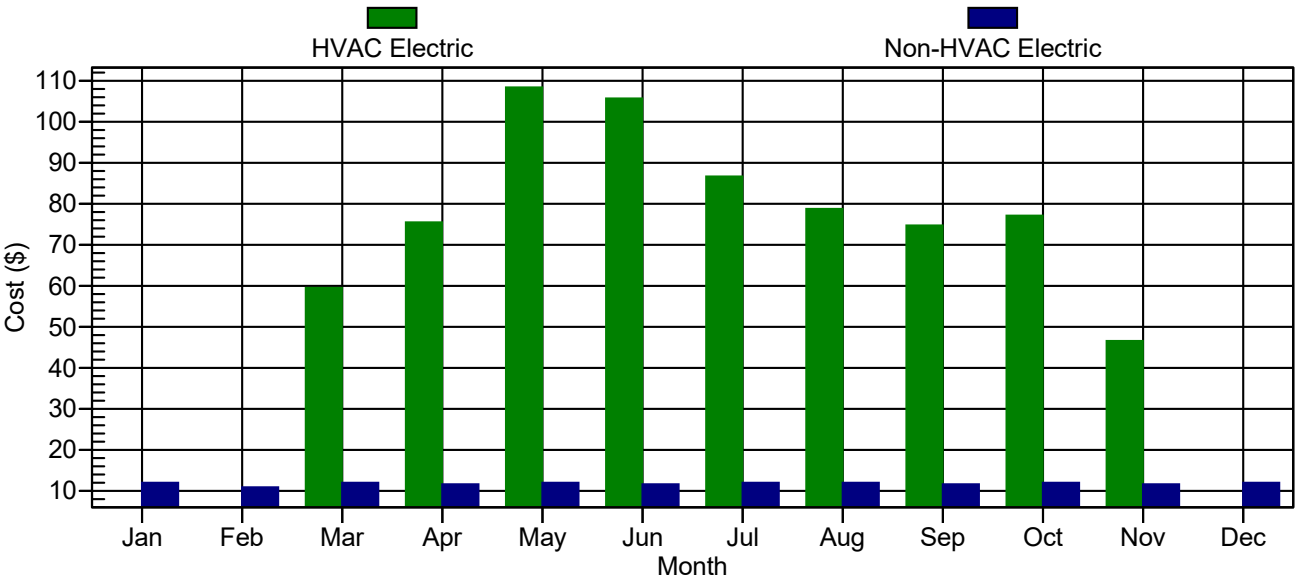
1. Annual Costs

Component	Annual Cost ($/yr)	($/ft²)	Percent of Total (%)
HVAC Components			
Electric	708	1.557	84.0
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	**708**	**1.557**	**84.0**
Non-HVAC Components			
Electric	135	0.297	16.0
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	**135**	**0.297**	**16.0**
Grand Total	**843**	**1.854**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **455.0** ft²
Conditioned Floor Area ..... **455.0** ft²

Monthly Energy Costs - Sample Building



1. HVAC Costs

Month	Electric ($)	Natural Gas ($)	Fuel Oil ($)	Propane ($)	Remote Hot Water ($)	Remote Steam ($)	Remote Chilled Water ($)
January	0	0	0	0	0	0	0
February	0	0	0	0	0	0	0
March	59	0	0	0	0	0	0
April	75	0	0	0	0	0	0
May	108	0	0	0	0	0	0
June	105	0	0	0	0	0	0
July	86	0	0	0	0	0	0
August	78	0	0	0	0	0	0
September	74	0	0	0	0	0	0
October	77	0	0	0	0	0	0
November	46	0	0	0	0	0	0
December	0	0	0	0	0	0	0
Total	**708**	**0**	**0**	**0**	**0**	**0**	**0**

2. Non-HVAC Costs

Month	Electric ($)	Natural Gas ($)	Fuel Oil ($)	Propane ($)	Remote Hot Water ($)	Remote Steam ($)
January	11	0	0	0	0	0
February	10	0	0	0	0	0
March	11	0	0	0	0	0
April	11	0	0	0	0	0
May	11	0	0	0	0	0
June	11	0	0	0	0	0
July	11	0	0	0	0	0
August	11	0	0	0	0	0
September	11	0	0	0	0	0
October	11	0	0	0	0	0
November	11	0	0	0	0	0
December	11	0	0	0	0	0
Total	**135**	**0**	**0**	**0**	**0**	**0**