Sample Reports

for

HAP 6.0 Example Problem

Carrier Software Systems
Carrier Corporation
Syracuse, New York

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Introduction

This document contains reports generated using the Carrier Hourly Analysis Program (HAP) 6.0 example problem. These reports have two uses:

- When working through the example problem in the help system as a means of learning the software. The following pages contain design load and energy modeling output reports as well as input data reports.
- When validating the installation of HAP by comparing example problem results calculated on your computer versus the reference results shown in the reports on the following pages. This type of validation verifies the software is properly installed and functioning on your computer. Some companies require this validation before accepting the software.

To review example problem reports for either purpose:

1. Start HAP.
2. If this is the first time running HAP:
   a. A new, untitled project will be created automatically.
   b. From the main window select the Open option on the Project menu.
   c. Navigate to the C:\Users\Public\Public Documents\Carrier Hourly Analysis Program folder. Select the *HAP60-Example-Problem.hap* project file found in this folder.
3. If HAP has been run previously and other projects have been created:
   a. Press the Browse button on the Open Project window that appears during startup.
   b. Navigate to the C:\Users\Public\Public Documents\Carrier Hourly Analysis Program folder. Select the *HAP60-Example-Problem.hap* project file in this folder.
4. Generate the set of design load reports found on the following pages.
   a. In the main window, click Alternatives in the left-hand navigation panel.
   b. In the right-hand list panel right-click the single alternative name. Select the Print/View Design Load Reports option on the pop-up menu that appears.
   c. In the Report selection window select the set of system design load reports shown on the following pages. Press Preview to view the reports. After the reports display you can save them to disk or print them.
5. Generate the set of energy modeling reports found on the following pages.
   a. In the main window, click Alternatives in the left-hand navigation panel.
   b. In the right-hand list panel right-click the single alternative name. Select the Print/View Energy Modeling Reports option on the pop-up menu that appears.
   c. In the Report selection window select the set of alternative and system reports shown on the following pages. Press Preview to view the reports. After the reports display you can save them to disk or print them.
6. If performing validation, compare your results with the reference results on the following pages.
   a. If the results match, then your installation is validated.
   b. If the results do not match, please send an e-mail to the software support help desk (software.systems@carrier.com) explaining your problem and attaching this PDF, the HAP60-Example-Problem.hap project file you used, and the reports you generated which do not match the reference results.

Selected
Design Load Reports

Air System Sizing Summary for VAV - Wing D

(In Alternative: ALT1 - VAV RTU)

Project: HAP60-Example-Problem 11/23/2022
Prepared by: Carrier 4:10 PM

Air System Information

Air System Name	**VAV - Wing D**		Number of zones	**11**	
Equipment Class	**PKG ROOF**		Floor Area	**9274.3**	sqft
Air System Type	**VAV**		Location	**Indianapolis Intl, IN, USA**	

Sizing Calculation Information

Calculation Months	**May to Nov**		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	**30.0**	Tons	Peak coil load occurs at	**August 16:00**	
Total coil load	**360.4**	MBH	OA DB / WB	**91.3 / 75.0**	F
Sensible coil load	**208.6**	MBH	Entering DB / WB	**85.1 / 70.8**	F
Coil CFM at peak load	**6218**	CFM	Leaving DB / WB	**53.7 / 52.3**	F
Sum of peak zone CFM	**6867**	CFM	Resulting RH	**50**	%
Sensible heat ratio	**0.579**		Design supply temp.	**55.0**	F
CFM/Ton	**207.0**		Zone T-stat Check	**11 of 11**	OK
sqft/Ton	**308.8**		Max zone temperature deviation	**0.0**	F
BTU/(hr sqft)	**38.9**				
Water flow @ 10.0 F rise	**N/A**				

Preheat Coil Sizing Data

Max coil load	**197.9**	MBH	Load occurs at	**Design Heating**	
Coil CFM at Design Heating	**4093**	CFM	Ent. DB / Lvg DB	**5.9 / 52.0**	F
Max coil CFM	**6429**	CFM			
Water flow @ 20.0 F drop	**N/A**				

Supply Fan Sizing Data

Design CFM	**6429**	CFM	Fan motor BHP	**3.52**	BHP
Design CFM occurs at	**August 17:00**		Fan motor kW	**2.79**	kW
Design CFM/sqft	**0.69**	CFM/sqft	Fan total static	**2.00**	in wg
Sum of peak zone CFM	**6867**	CFM			
VAV Fan Diversity	**6.4**	%			

Outdoor Ventilation Air Data

Design airflow CFM	**3882**	CFM	CFM/person	**18.58**	CFM/person
CFM/sqft	**0.42**	CFM/sqft			

Zone Sizing Summary for VAV - Wing D

(In Alternative: ALT1 - VAV RTU)

Project: HAP60-Example-Problem 11/23/2022
Prepared by: Carrier 4:10 PM

Air System Information

Air System Name ..... **VAV - Wing D**
Equipment Class ..... **PKG ROOF**
Air System Type ..... **VAV**
Number of zones **11**
Floor Area ..... **9274.3** sqft
Location ..... **Indianapolis Intl, IN, USA**

Sizing Calculation Information

Calculation Months ..... **May to Nov**
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/sqft	Reheat Coil Capacity (MBH)	Reheat Coil Water gpm @ 20.0 F	Zone Htg Unit Coil Capacity (MBH)	Zone Htg Unit Water gpm @ 20.0 F	Mixing Box Fan Airflow (CFM)
D101 - Classroom	741	456	0.85	16.8	-	0.0	-	0
D102 - Classroom	724	449	0.88	16.5	-	0.0	-	0
D103 - Classroom	749	459	0.84	16.9	-	0.0	-	0
D104 - Classroom	751	459	0.84	16.8	-	0.0	-	0
D105 - South Vestibule	128	32	1.98	4.7	-	0.0	-	0
D106 - Classroom	842	455	0.97	16.7	-	0.0	-	0
D107 - Classroom	803	457	0.92	16.8	-	0.0	-	0
D108 - Classroom	1469	931	0.72	34.2	-	0.0	-	0
D112 - West Vestibule	137	34	2.01	5.0	-	0.0	-	0
D113 - West Corridor	270	71	0.28	3.5	-	0.0	-	0
D114 - South Corridor	254	70	0.27	3.2	-	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 (sqft)
D101 - Classroom	15.6	July 11:00	5.2	873.4
D102 - Classroom	15.2	July 11:00	5.0	825.7
D103 - Classroom	15.7	July 11:00	5.5	892.2
D104 - Classroom	15.8	July 11:00	7.2	890.0
D105 - South Vestibule	2.2	November 13:00	2.7	64.6
D106 - Classroom	17.7	July 18:00	7.6	864.4
D107 - Classroom	16.8	July 18:00	5.3	877.1
D108 - Classroom	30.8	August 16:00	10.1	2029.3
D112 - West Vestibule	2.9	August 18:00	2.8	68.0
D113 - West Corridor	5.7	July 7:00	2.0	949.7
D114 - South Corridor	5.3	July 7:00	1.8	939.9

Space Loads and Airflows

Zone Name / Space Name	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (sqft)	Space CFM/sqft
D101 - Classroom						
D101 - Classroom	15.6	July 11:00	741	5.2	873.4	0.85
D102 - Classroom						
D102 - Classroom	15.2	July 11:00	724	5.0	825.7	0.88
D103 - Classroom						
D103 - Classroom	15.7	July 11:00	749	5.5	892.2	0.84
D104 - Classroom						
D104 - Classroom	15.8	July 11:00	751	7.2	890.0	0.84

Zone Sizing Summary for VAV - Wing D

(In Alternative: ALT1 - VAV RTU)

Project: HAP60-Example-Problem 11/23/2022

Prepared by: Carrier 4:10 PM

Zone Name / Space Name	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (sqft)	Space CFM/sqft
D105 - South Vestibule						
D105 - South Vestibule	2.2	November 13:00	128	2.7	64.6	1.98
D106 - Classroom						
D106 - Classroom	17.7	July 18:00	842	7.6	864.4	0.97
D107 - Classroom						
D107 - Classroom	16.8	July 18:00	803	5.3	877.1	0.92
D108 - Classroom						
D108 - Classroom	27.4	August 16:00	1303	7.0	1712.7	0.76
D111 - Office	1.9	July 7:00	92	1.2	146.0	0.63
D110 - Storage	0.9	July 19:00	41	1.0	109.6	0.38
D109 - Practice Room	1.2	August 18:00	56	0.9	61.0	0.91
D112 - West Vestibule						
D112 - West Vestibule	2.9	August 18:00	137	2.8	68.0	2.01
D113 - West Corridor						
D113 - West Corridor	5.7	July 7:00	270	2.0	949.7	0.28
D114 - South Corridor						
D114 - South Corridor	5.3	July 7:00	254	1.8	939.9	0.27

Ventilation Sizing Summary for VAV - Wing D

(In Alternative: ALT1 - VAV RTU)

Project: HAP60-Example-Problem 11/23/2022
Prepared by: Carrier 4:10 PM

1. Summary

Ventilation Sizing Method ..... **ASHRAE Standard 62.1-2016**
Design Condition ..... **Minimum flow (heating)**
Occupant Diversity (D) **1.000**
Uncorrected Outdoor Air Intake (Vou) ..... **3053** CFM
System Ventilation Efficiency (Ev) **0.786**
Outdoor Air Intake (Vot) ..... **3882** CFM

2. Space Ventilation Analysis

Zone Name / Space Name	Minimum Supply Air (CFM) (Vpz)	Space Floor Area (sqft) (Az)	Area Outdoor Air Rate (CFM/sqft) (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)
D101 - Classroom									
D101 - Classroom	456	873.4	0.12	26.0	10.00	0.80	**456**	*365*	0.786
D102 - Classroom									
D102 - Classroom	449	825.7	0.12	26.0	10.00	0.80	**449**	*359*	0.786
D103 - Classroom									
D103 - Classroom	459	892.2	0.12	26.0	10.00	0.80	**459**	*367*	0.786
D104 - Classroom									
D104 - Classroom	459	890.0	0.12	26.0	10.00	0.80	**459**	*367*	0.786
D105 - South Vestibule									
D105 - South Vestibule	32	64.6	0.06	0.0	0.00	0.80	**5**	*4*	1.635
D106 - Classroom									
D106 - Classroom	455	864.4	0.12	26.0	10.00	0.80	**455**	*364*	0.786
D107 - Classroom									
D107 - Classroom	457	877.1	0.12	26.0	10.00	0.80	**457**	*365*	0.786
D108 - Classroom									
D108 - Classroom	894	1712.7	0.12	51.0	10.00	0.80	**894**	*716*	0.786
D111 - Office	23	146.0	0.06	1.0	5.00	0.80	**17**	*14*	1.025
D110 - Storage	10	109.6	0.06	0.0	5.00	0.80	**8**	*7*	0.981
D109 - Practice Room	14	61.0	0.06	1.0	5.00	0.80	**11**	*9*	0.996
D112 - West Vestibule									
D112 - West Vestibule	34	68.0	0.06	0.0	0.00	0.80	**5**	*4*	1.637
D113 - West Corridor									
D113 - West Corridor	71	949.7	0.06	0.0	0.00	0.80	**71**	*57*	0.786
D114 - South Corridor									
D114 - South Corridor	70	939.9	0.06	0.0	0.00	0.80	**70**	*56*	0.786
Totals	**3882**							**3053**	**0.786**

Air System Heat Balance Summary for VAV - Wing D

(In Alternative: ALT1 - VAV RTU)

Project: HAP60-Example-Problem 11/23/2022

Prepared by: Carrier 4:10 PM

Table 1. System Loads

	DESIGN COOLING - AUGUST 16:00			DESIGN HEATING		
	OA DB / WB 91.3 F / 75.0 F			OA DB / WB 2.6 F / 0.9 F		
COMPONENT LOADS	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Zone Conditioning	-	133105	41447	-	55610	0
Plenum Load	-	0	0	-	0	0
Return Fan Load	6218 CFM	0	-	4093 CFM	0	-
Ventilation Load	3882 CFM	65702	103867	3882 CFM	274245	0
Supply Fan Load	6218 CFM	8759	-	4093 CFM	-3612	-
Zone Fan Coil Fans Load	-	0	-	-	0	-
>> Total System Loads	**-**	**207565**	**145314**	**-**	**326243**	**0**
Central Cooling Coil	-	208648	151751	-	0	0
Preheat Coil	-	0	-	-	197944	-
Terminal Reheat Coils	-	0	-	-	129156	-
>> Total Conditioning	**-**	**208648**	**151751**	**-**	**327099**	**0**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

Table 2. Zone Heat Balance Loads

	DESIGN COOLING - AUGUST 16:00			DESIGN HEATING		
	OA DB / WB 91.3 F / 75.0 F			OA DB / WB 2.6 F / 0.9 F		
Zone Heat Balance Component	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**	**Details**	**Sensible [BTU/hr]**	**Latent [BTU/hr]**
Exterior Wall Convection	2343 sqft	8355	-	2343 sqft	6667	-
Roof Convection	0 sqft	0	-	0 sqft	0	-
Window Convection	441 sqft	3955	-	441 sqft	4741	-
Skylight Convection	0 sqft	0	-	0 sqft	0	-
Door Convection	95 sqft	911	-	95 sqft	2581	-
Floor Convection	9274 sqft	24404	-	9274 sqft	15169	-
Interior Wall Convection	9837 sqft	16099	-	9837 sqft	4964	-
Ceiling Convection	9274 sqft	39682	-	9274 sqft	20825	-
Overhead Lighting Convection	5372 W	8138	-	0 W	0	-
Task Lighting Convection	0 W	0	-	0 W	0	-
Electric Equipment Convection	6397 W	16371	-	0 W	0	-
People Convection	209	15362	42845	0	0	0
Infiltration	5 CFM	81	130	6 CFM	402	0
Miscellaneous Equipment	-	0	0	-	0	0
Air Internal Energy Change	-	0		-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**133358**	**42975**	**-**	**55349**	**0**
Key:	**Positive values are cooling loads Negative values are heating loads**			**Positive values are heating loads Negative values are cooling loads**		

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

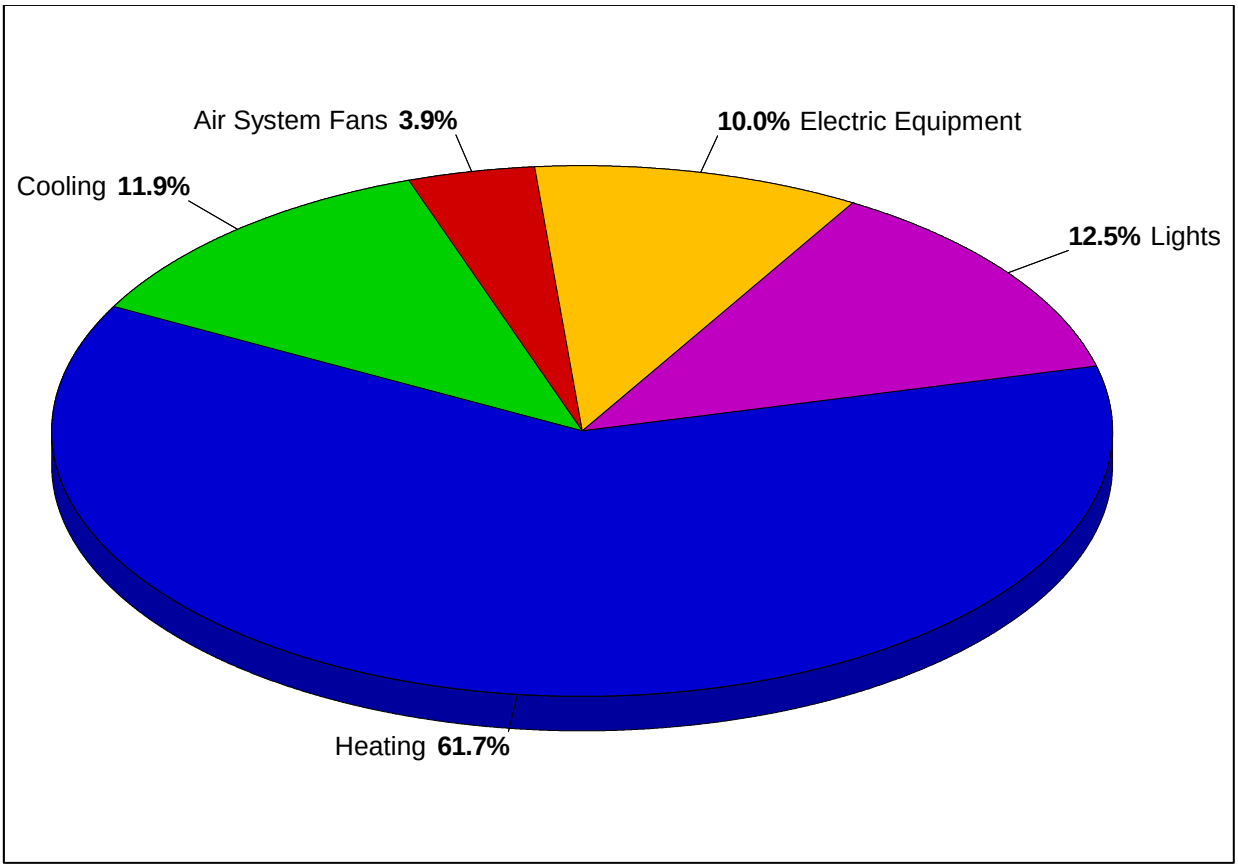
Note 2: Lighting, equipment, and people line items include only the direct convective heat gain from the heat source to the room air. The radiative portion of the heat gain is first absorbed by surfaces in the room and then later convected from the surface to the air. Therfore the effect of the radiative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

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

Selected
Energy Modeling Reports

Annual Component Costs - ALT1 - VAV RTU

Project: HAP60-Example-Problem 11/23/2022
Prepared by: Carrier 4:10 PM



1. Annual Costs

Component	Annual Cost ($)	($/sqft)	Percent of Total (%)
Air System Fans	646	0.070	3.9
Cooling	1,974	0.213	11.9
Heating	10,213	1.101	61.7
Pumps	0	0.000	0.0
Heat Rejection Fans	0	0.000	0.0
HVAC Sub-Total	**12,833**	**1.384**	**77.5**
Lights	2,075	0.224	12.5
Electric Equipment	1,649	0.178	10.0
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**3,723**	**0.402**	**22.5**
Grand Total	**16,557**	**1.785**	**100.0**

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

Gross Floor Area ..... **9,274.3** sqft
Modeled Floor Area ..... **9,274.3** sqft

1. Monthly Energy Use by System Component

Component	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air System Fans (kWh)	744	653	661	432	367	315	182	286	354	468	586	717
Cooling												
Electric (kWh)	24	72	368	627	2819	3882	1680	3401	3416	1174	140	10
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote CW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Heating												
Electric (kWh)	21509	15948	11949	4718	1901	343	0	160	563	4948	10470	18592
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0
Pumps (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Heat Rej. Fans (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Lighting (kWh)	1789	1691	1929	1435	1789	1564	296	1218	1780	1795	1710	1509
Electric Eqpt. (kWh)	1422	1343	1533	1139	1422	1244	238	969	1414	1425	1358	1199
Misc. Electric (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Misc. Fuel												
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0

Billing Details - Electric - ALT1 - VAV RTU

Project: HAP60-Example-Problem 11/23/2022
Prepared by: Carrier 4:10 PM

1. Component Charges

Billing Period	Energy Charges ($)	Demand Charges ($)	Customer Charges ($)	Taxes ($)	Total Charge ($)
Jan	2,857	0	0	0	2,857
Feb	2,209	0	0	0	2,209
Mar	1,843	0	0	0	1,843
Apr	936	0	0	0	936
May	930	0	0	0	930
Jun	824	0	0	0	824
Jul	269	0	0	0	269
Aug	677	0	0	0	677
Sep	844	0	0	0	844
Oct	1,100	0	0	0	1,100
Nov	1,599	0	0	0	1,599
Dec	2,469	0	0	0	2,469
Totals	16,557	0	0	0	16,557

2. Totals

Billing Period	Total Charges ($)	Total Consumption (kWh)	Avg Price ($/kWh)
Jan	2,857	25,489	0.1121
Feb	2,209	19,706	0.1121
Mar	1,843	16,441	0.1121
Apr	936	8,351	0.1121
May	930	8,299	0.1121
Jun	824	7,348	0.1121
Jul	269	2,397	0.1121
Aug	677	6,035	0.1121
Sep	844	7,527	0.1121
Oct	1,100	9,810	0.1121
Nov	1,599	14,264	0.1121
Dec	2,469	22,027	0.1121
Totals	16,557	147,695	0.1121

3. Consumption Totals

Billing Period	Peak (kWh)	Mid-Peak (kWh)	Normal Peak (kWh)	Off-Peak (kWh)	Overall (kWh)
Jan	0	0	0	0	25,489
Feb	0	0	0	0	19,706
Mar	0	0	0	0	16,441
Apr	0	0	0	0	8,351
May	0	0	0	0	8,299
Jun	0	0	0	0	7,348
Jul	0	0	0	0	2,397
Aug	0	0	0	0	6,035
Sep	0	0	0	0	7,527
Oct	0	0	0	0	9,810
Nov	0	0	0	0	14,264
Dec	0	0	0	0	22,027
Totals	0	0	0	0	147,695

4. Billing Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	104.7
Feb	0.0	0.0	0.0	0.0	99.0
Mar	0.0	0.0	0.0	0.0	72.2
Apr	0.0	0.0	0.0	0.0	64.9
May	0.0	0.0	0.0	0.0	56.3
Jun	0.0	0.0	0.0	0.0	34.4
Jul	0.0	0.0	0.0	0.0	14.2
Aug	0.0	0.0	0.0	0.0	36.9
Sep	0.0	0.0	0.0	0.0	31.5
Oct	0.0	0.0	0.0	0.0	71.2
Nov	0.0	0.0	0.0	0.0	75.0
Dec	0.0	0.0	0.0	0.0	104.5

5. Maximum Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	104.7
Feb	0.0	0.0	0.0	0.0	99.0
Mar	0.0	0.0	0.0	0.0	72.2
Apr	0.0	0.0	0.0	0.0	64.9
May	0.0	0.0	0.0	0.0	56.3
Jun	0.0	0.0	0.0	0.0	34.4
Jul	0.0	0.0	0.0	0.0	14.2
Aug	0.0	0.0	0.0	0.0	36.9
Sep	0.0	0.0	0.0	0.0	31.5
Oct	0.0	0.0	0.0	0.0	71.2
Nov	0.0	0.0	0.0	0.0	75.0
Dec	0.0	0.0	0.0	0.0	104.5

6. Time Of Maximum Demands (Date/Hour)

Billing Period	Peak	Mid-Peak	Normal Peak	Off-Peak	Overall
Jan	n/a	n/a	n/a	n/a	1/18 08:00
Feb	n/a	n/a	n/a	n/a	2/4 08:00
Mar	n/a	n/a	n/a	n/a	3/25 06:00
Apr	n/a	n/a	n/a	n/a	4/4 06:00
May	n/a	n/a	n/a	n/a	5/9 06:00
Jun	n/a	n/a	n/a	n/a	6/8 13:00
Jul	n/a	n/a	n/a	n/a	7/16 10:00
Aug	n/a	n/a	n/a	n/a	8/31 13:00
Sep	n/a	n/a	n/a	n/a	9/14 12:00
Oct	n/a	n/a	n/a	n/a	10/25 06:00
Nov	n/a	n/a	n/a	n/a	11/29 07:00
Dec	n/a	n/a	n/a	n/a	12/20 08:00

Monthly Simulation Results for VAV - Wing D

(In Alternative: ALT1 - VAV RTU)

Project: HAP60-Example-Problem 11/23/2022

Prepared by: Carrier 4:10 PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kBTU)	Preheat Coil Input (kWh)	Central Cooling Coil Load (kBTU)	Central Unit Clg Input (kWh)	Terminal Heating Coil Load (kBTU)	Terminal Heating Coil Input (kWh)	Supply Fan (kWh)
January	30159	8839	336	24	43234	12671	744
February	19769	5794	987	72	34647	10154	653
March	10198	2989	4969	368	30569	8959	660
April	810	237	8770	627	15296	4483	432
May	75	22	39311	2819	6413	1880	367
June	0	0	53413	3882	1172	343	315
July	0	0	18990	1680	0	0	182
August	0	0	44959	3401	547	160	286
September	0	0	45922	3416	1921	563	354
October	3251	953	16820	1174	13633	3996	468
November	9563	2803	1970	140	26161	7667	586
December	23387	6854	137	10	40052	11738	717
Total	**97211**	**28490**	**236582**	**17613**	**213645**	**62613**	**5765**

Air System Simulation Results (Table 2) :

Month	Lighting (kWh)	Electric Equipment (kWh)
January	1789	1422
February	1691	1343
March	1929	1533
April	1435	1139
May	1789	1422
June	1564	1244
July	296	238
August	1218	969
September	1780	1414
October	1795	1425
November	1710	1359
December	1509	1199
Total	**18507**	**14707**

Input Data Reports

Design Weather Parameters

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:19 PM

Design Parameters:

Location	**Indianapolis Intl, IN, USA**	
Latitude	**39.73**	°N (+ : north, - : south)
Longitude	**-86.28**	°E (+ : east, - : west)
Elevation	**790.0**	ft
Climate Zone	**4A - Mixed Humid**	
Local Time Zone	**-5.0**	hours from GMT (+ : east, - : west)
Summer Design Condition	**0.4% Cooling**	
Summer Design Dry-Bulb	**91.3**	F
Summer Coincident Wet-Bulb	**75.0**	F
Summer Daily Range	**17.9**	F
Hottest Month	**July**	
Winter Design Condition	**99.6% Heating**	
Winter Design Dry-Bulb	**2.6**	F
Winter Design Wet-Bulb	**0.9**	F
Outdoor Air CO2 Level	**400**	ppm
Average Ground Reflectance	**0.20**	
Soil Conductivity	**0.800**	BTU/(hr ft F)
Design Cooling Months	**May to November**	
Consider Daylight Savings Time	**Yes**	
Daylight Savings Begins	**March 4**	
Daylight Savings Ends	**November 1**	
Simulation Weather Data	**Indianapolis Intl AP (TMYx_2004_2018)**	
Current Data is	**ASHRAE Default**	

Design Day Maximum Solar Fluxes

(The flux values are expressed in BTU/(hr sqft))

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	21.1	21.1	26.6	106.6	173.5	234.3	267.5	283.1	283.7
February	26.5	26.5	68.7	144.0	210.3	250.6	274.2	274.9	269.0
March*	31.3	39.1	118.1	183.5	234.2	261.3	260.8	245.7	234.8
April*	36.4	86.6	150.8	207.5	235.7	241.8	221.2	194.3	181.0
May*	50.2	115.2	170.0	214.5	231.1	219.6	190.6	153.9	138.5
June*	61.5	125.8	177.5	216.6	227.4	210.6	176.8	137.5	120.7
July*	49.7	111.6	167.5	209.5	223.0	214.9	183.5	150.2	133.5
August*	36.2	78.6	142.1	192.8	217.6	227.4	209.3	184.8	171.6
September*	31.7	38.5	103.3	164.7	208.1	236.5	236.8	225.3	218.3
October*	25.5	25.5	64.3	131.8	192.6	237.6	256.5	258.1	256.9
November	20.7	20.7	32.9	95.7	170.6	221.3	260.5	274.1	276.7
December	19.0	19.0	19.0	88.8	158.0	219.6	259.5	279.5	283.3
Month	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**HOR**	**Mult**
January	282.0	265.9	235.1	171.7	106.3	29.2	21.1	161.5	1.00
February	274.9	274.0	251.2	210.0	144.4	67.9	26.5	207.6	1.00
March*	246.0	261.5	258.8	236.5	181.0	117.5	42.3	253.3	1.00
April*	195.8	224.2	240.7	237.8	202.3	153.6	85.5	286.1	1.00
May*	155.8	191.7	221.1	230.6	211.9	174.3	113.2	298.5	1.00
June*	139.3	177.5	212.5	225.3	216.4	181.4	122.0	299.7	1.00
July*	151.2	185.6	215.4	222.6	208.2	169.8	108.8	291.8	1.00
August*	185.6	211.2	225.7	222.0	188.2	142.7	79.4	273.0	1.00
September*	225.0	236.6	235.2	209.9	165.6	98.9	40.7	238.6	1.00
October*	258.2	256.6	237.5	192.8	131.5	64.4	25.5	195.9	1.00
November	273.8	260.4	222.2	170.5	94.6	33.0	20.7	156.8	1.00
December	278.1	260.7	218.7	160.7	81.2	21.8	19.0	142.8	1.00

Mult. = User-defined solar multiplier factor.
* : Daylight Saving Month

1. General Information

Building ..... School Wing D
Default Level-to-Level Height ..... 12'
Default Floor-to-Ceiling Height ..... 9'
Default Window Opening Elevation ..... 2' 6"
Notes ..... None

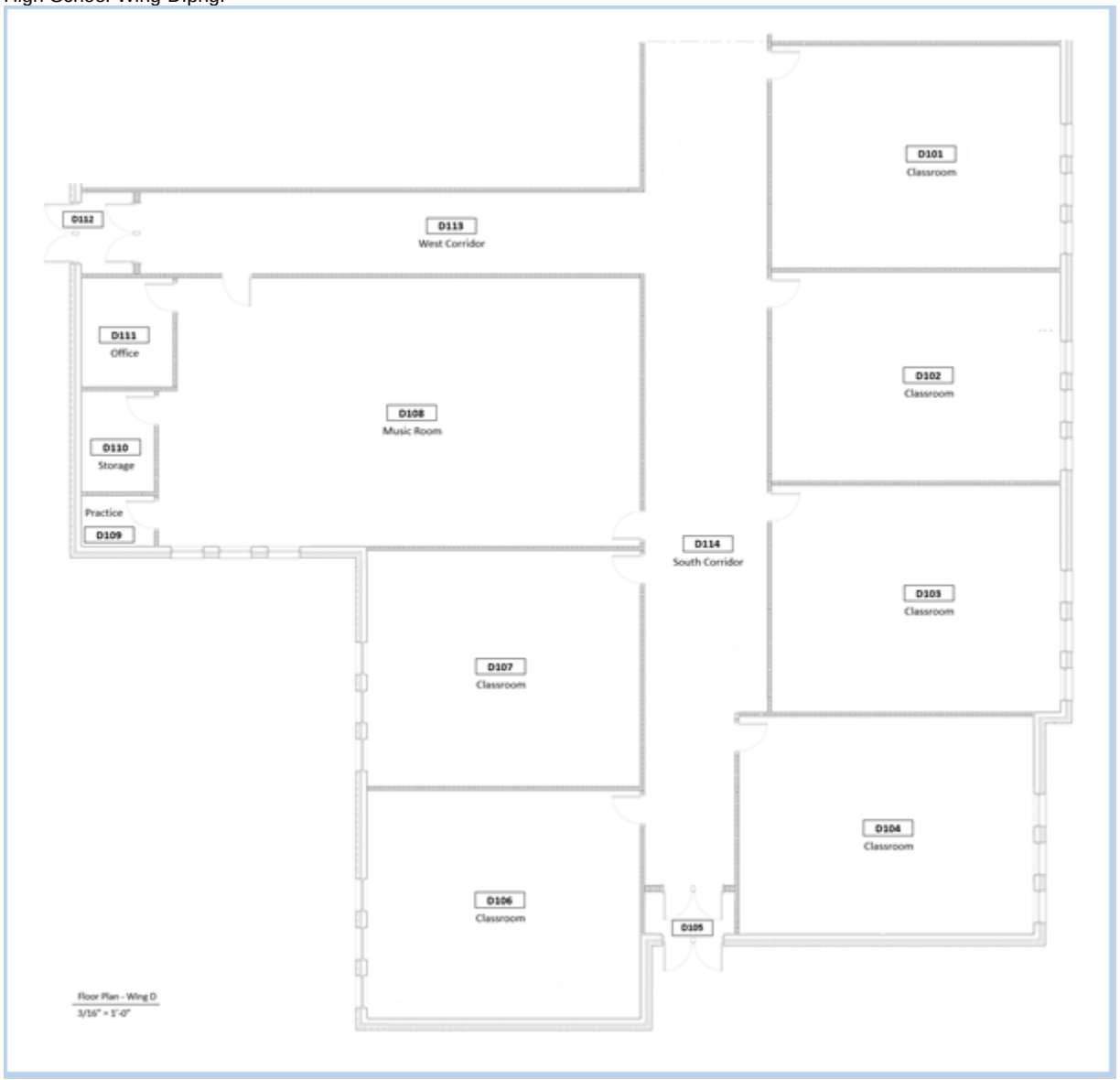
2. Floor Plan Images

2.1. Summary of Floor Plan Images

Floor Plan Image	North Orientation (deg)	Scale	Used in Level(s)
High-School-Wing-D.png	0.0	3/16" = 1'0"	Level 1

2.2. Floor Plan Images

High-School-Wing-D.png:



3. Levels

Summary of Level Data

Level	Vertical Position	Override General Defaults	Level-to-Level Height	Floor-to-Ceiling Height	Default Opening Elevation	Ceiling Space Height	Raised Floor Height	Associated Floor Plan Image
Level 1	At-grade	Yes	12'	9'	2' 6"	3'	-	High-School-Wing-D.png

4. Walls & Spaces, Roofs

4.1. Building Summary

Level	Space Count	Floor Area (sqft)	Volume (cuft)	Interior Wall Gross Area (sqft)	Exterior Wall Gross Area (sqft)
Level 1	14	9274.9	83361.8	10097.3	3846.6

4.2. Building Summary (Roof Levels)

Level	Section Count	Total Roof Area (sqft)	Heat Transfer Area (sqft)	Exterior Wall Gross Area (sqft)
Implied Roofs	14	9274.3	9274.3	0.0

4.3. Space Details

Space	Floor Area (sqft)	Volume (cuft)	Interior Wall Gross Area (sqft)	Exterior Wall Gross Area (sqft)	Multi-Level	Notes
Level 1						
D101 - Classroom	873.9	7850.4	840.3	232.1	No	
D102 - Classroom	826.1	7421.5	827.6	219.4	No	
D103 - Classroom	891.8	8020.0	817.8	264.6	No	
D104 - Classroom	890.7	8000.1	542.1	542.1	No	
D105 - South Vestibule	64.6	580.7	204.7	96.7	No	
D106 - Classroom	864.2	7770.0	444.5	616.7	No	
D107 - Classroom	876.4	7883.5	825.2	243.0	No	
D108 - Classroom	1713.0	15394.8	1354.3	211.8	No	
D109 - Practice Room	61.2	548.0	142.2	142.2	No	
D110 - Storage	109.7	985.3	272.2	107.6	No	
D111 - Office	146.1	1312.3	319.7	115.6	No	
D112 - West Vestibule	68.0	611.2	212.9	87.9	No	
D113 - West Corridor	949.6	8536.2	1776.1	0.0	No	
D114 - South Corridor	939.5	8447.9	1517.7	0.0	No	
Ceiling/Floor Spaces	-	27990.1	-	966.9	-	

4.4. Roof Details

Name	Shape	Total Area (sqft)	Heat Transfer Area (sqft)	Pitch		Notes
				Pitch A	Pitch B	
Level 1						
Ceiling Space for D104 - Classroom	Flat	890.0	890.0	-	-	
Ceiling Space for D105 - South Vestibule	Flat	64.6	64.6	-	-	
Ceiling Space for D107 - Classroom	Flat	877.1	877.1	-	-	
Ceiling Space for D106 - Classroom	Flat	864.4	864.4	-	-	
Ceiling Space for D108 - Classroom	Flat	1712.7	1712.7	-	-	
Ceiling Space for D111 - Office	Flat	146.0	146.0	-	-	
Ceiling Space for D110 - Storage	Flat	109.6	109.6	-	-	
Ceiling Space for D109 - Practice Room	Flat	61.0	61.0	-	-	
Ceiling Space for D112 - West Vestibule	Flat	68.0	68.0	-	-	
Ceiling Space for D101 - Classroom	Flat	873.4	873.4	-	-	
Ceiling Space for D103 - Classroom	Flat	892.2	892.2	-	-	
Ceiling Space for D102 - Classroom	Flat	825.7	825.7	-	-	
Ceiling Space for D114 - South Corridor	Flat	939.9	939.9	-	-	
Ceiling Space for D113 - West Corridor	Flat	949.7	949.7	-	-	

4.5. Unmodeled Space Details

Unmodeled Spaces	Level	Notes
Unmodeled	Level 1	

4.6. Summary of Wall Groups

Wall Group	Interior Wall Gross Area (sqft)	Exterior Wall Gross Area (sqft)	Notes
Default	9836.5	3846.6	
Air Walls	260.7	0.0	

5. Openings

5.1. Schedule of Window Openings

Tag	Count	Total Area (sqft)	Width	Height	Elevation	Exterior Shade	Notes
W01	21	441.0	3' 6"	6'	2' 6"	None	Standard size window opening

5.2. Schedule of Door Openings

Tag	Count	Total Area (sqft)	Width	Height	Shade	Notes
D01	2	95.4	6' 10"	7'	Entrance Porch Roof Overhang	Entrance door

5.3. Schedule of Skylight Openings

None

1. General Information

Space Model ..... School Wing D
Building ..... School Wing D
Notes:

2. Spaces

The space model contains 14 spaces with total floor area of 9,275 sqft.

2.1. Ventilation

Index	Space	Level	Floor Area (sqft)	Space Type	Ventilation						
					ASHRAE Standard 62.1-2016 Space Usage	OA Requirement 1		OA Requirement 2		Direct Exhaust	
						Airflow	Units	Airflow	Units	Airflow	Units
1	D101 - Classroom	Level 1	873.9	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
2	D102 - Classroom	Level 1	826.1	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
3	D103 - Classroom	Level 1	891.8	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
4	D104 - Classroom	Level 1	890.7	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
5	D105 - South Vestibule	Level 1	64.6	Corridor - All Others	GENERAL: Corridor	0.0	CFM/person	0.06	CFM/sqft	0.0	CFM
6	D106 - Classroom	Level 1	864.2	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
7	D107 - Classroom	Level 1	876.4	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
8	D108 - Classroom	Level 1	1713.0	Classroom - Ages 9+	EDUCATION: Classroom (age 9 plus)	10.0	CFM/person	0.12	CFM/sqft	0.0	CFM
9	D109 - Practice Room	Level 1	61.2	Office - Enclosed, Small	OFFICE: Office space	5.0	CFM/person	0.06	CFM/sqft	0.0	CFM
10	D110 - Storage	Level 1	109.7	Storage Room - Medium	OFFICE: Occupiable storage room for dry materials	5.0	CFM/person	0.06	CFM/sqft	0.0	CFM
11	D111 - Office	Level 1	146.1	Office - Enclosed, Small	OFFICE: Office space	5.0	CFM/person	0.06	CFM/sqft	0.0	CFM
12	D112 - West Vestibule	Level 1	68.0	Corridor - All Others	GENERAL: Corridor	0.0	CFM/person	0.06	CFM/sqft	0.0	CFM
13	D113 - West Corridor	Level 1	949.6	Corridor - All Others	GENERAL: Corridor	0.0	CFM/person	0.06	CFM/sqft	0.0	CFM
14	D114 - South Corridor	Level 1	939.5	Corridor - All Others	GENERAL: Corridor	0.0	CFM/person	0.06	CFM/sqft	0.0	CFM

2.2. Overhead Lighting and Daylighting Control

Index	Space	Overhead Lighting							Daylighting Control		
		ASHRAE Standard 90.1-2016		Power	Units	Lighting Type	Schedule	Power Multi.	Control Type	Illum. Setpoint	Units
		Lighting Method	Space Usage								
1	D101 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
2	D102 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
3	D103 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
4	D104 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
5	D105 - South Vestibule	Space by Space	Corridor: All others	0.66	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---
6	D106 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
7	D107 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
8	D108 - Classroom	Space by Space	Classroom/Lecture Hall: All others	0.92	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 School Lights/Elec	1.00	Not Used	---	---
9	D109 - Practice Room	Space by Space	Office: Enclosed and <= 250 ft2	0.93	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---
10	D110 - Storage	Space by Space	Storage Room: >= 50 ft2 and <=1000 ft2	0.46	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---
11	D111 - Office	Space by Space	Office: Enclosed and <= 250 ft2	0.93	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---
12	D112 - West Vestibule	Space by Space	Corridor: All others	0.66	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---
13	D113 - West Corridor	Space by Space	Corridor: All others	0.66	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---
14	D114 - South Corridor	Space by Space	Corridor: All others	0.66	W/sqft	Fluorescent: Recessed, no Lens, Unvented	90.1 Office Lights/Elec	1.00	Not Used	---	---

2.3. Task Lighting, Electric Equipment and Miscellaneous Heat Gain

Index	Space	Task Lighting			Electric Equipment			Miscellaneous Heat Gain			
		Power	Units	Schedule	Power	Units	Schedule	Sens. (BTU/hr)	Schedule	Latent (BTU/hr)	Schedule
1	D101 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
2	D102 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
3	D103 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
4	D104 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
5	D105 - South Vestibule	0.00	W/sqft	(None)	0.00	W/sqft	(None)	0	(None)	0	(None)
6	D106 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
7	D107 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
8	D108 - Classroom	0.00	W/sqft	(None)	0.90	W/sqft	90.1 School Lights/Elec	0	(None)	0	(None)
9	D109 - Practice Room	0.00	W/sqft	(None)	0.75	W/sqft	90.1 Office Lights/Elec	0	(None)	0	(None)
10	D110 - Storage	0.00	W/sqft	(None)	0.00	W/sqft	(None)	0	(None)	0	(None)
11	D111 - Office	0.00	W/sqft	(None)	0.75	W/sqft	90.1 Office Lights/Elec	0	(None)	0	(None)
12	D112 - West Vestibule	0.00	W/sqft	(None)	0.00	W/sqft	(None)	0	(None)	0	(None)
13	D113 - West Corridor	0.00	W/sqft	(None)	0.00	W/sqft	(None)	0	(None)	0	(None)
14	D114 - South Corridor	0.00	W/sqft	(None)	0.00	W/sqft	(None)	0	(None)	0	(None)

2.4. Occupancy and Infiltration

Index	Space	Occupants						Infiltration				
		Occupancy	Units	Schedule	Activity Level	Sens. (BTU/hr/person)	Latent (BTU/hr/person)	Cooling Airflow	Heating Airflow	Simulation Airflow	Units	Occurs
1	D101 - Classroom	26	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
2	D102 - Classroom	26	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
3	D103 - Classroom	26	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
4	D104 - Classroom	26	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
5	D105 - South Vestibule	0	People	(None)	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	All Hours
6	D106 - Classroom	26	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
7	D107 - Classroom	26	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
8	D108 - Classroom	51	People	90.1 School Occupancy	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
9	D109 - Practice Room	1	People	90.1 Office Occupancy	Office Work	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
10	D110 - Storage	0	People	(None)	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
11	D111 - Office	1	People	90.1 Office Occupancy	Office Work	245.0	205.0	0.25	0.25	0.25	ACH	Unoccupied
12	D112 - West Vestibule	0	People	(None)	User Defined	245.0	205.0	0.25	0.25	0.25	ACH	All Hours
13	D113 - West Corridor	0	People	(None)	User Defined	245.0	205.0	0.00	0.00	0.00	ACH	Unoccupied
14	D114 - South Corridor	0	People	(None)	User Defined	245.0	205.0	0.00	0.00	0.00	ACH	Unoccupied

3. Zoning

Zone	Space	Level
D101 - Classroom		
	D101 - Classroom	Level 1
D102 - Classroom		
	D102 - Classroom	Level 1
D103 - Classroom		
	D103 - Classroom	Level 1
D104 - Classroom		
	D104 - Classroom	Level 1
D105 - South Vestibule		
	D105 - South Vestibule	Level 1
D106 - Classroom		
	D106 - Classroom	Level 1
D107 - Classroom		
	D107 - Classroom	Level 1
D108 - Classroom		
	D108 - Classroom	Level 1
	D109 - Practice Room	Level 1
	D110 - Storage	Level 1
	D111 - Office	Level 1
D112 - West Vestibule		
	D112 - West Vestibule	Level 1
D113 - West Corridor		
	D113 - West Corridor	Level 1
D114 - South Corridor		
	D114 - South Corridor	Level 1
Unconditioned (no spaces)		

Zone	Space	Level
Unassigned (no spaces)		

4. Assemblies

Category	Surface Group	Selected Assembly
Exterior Above Grade Wall		
	Default	2016 Zone 4 Above-grade steel-framed wall
Interior Wall		
	Default	Interior Gypsum Board Wall
Roof		
	Default	2016 Zone 4 Insulation entirely above deck
Ceiling		
	Interior Ceilings	Acoustic Tile Ceiling
Slab Floor On Grade		
	At-Grade Floors	2016 Zone 4 Slab-on-grade floor, unheated

5. Windows & Doors

Category	Tag	Width x Height, Elevation	Selected Assembly
Window			
	W01	3' 6" x 6' , 2' 6"	2016 Zone 4 Metal framing, fixed
Door			
	D01	6' 10" x 7'	2016 Zone 4 Glass, metal framing, entrance door

VAV - Wing D Input Data

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:20 PM

1. General Details:

Air System Name ..... **VAV - Wing D**
Equipment Type ..... **Packaged Rooftop Units**
Air System Type ..... **VAV**
Space Model: ..... **School Wing D**
Notes:

2. System Components:

Ventilation Air Data:

Airflow Control ..... **Constant Ventilation Airflow**
Ventilation Sizing Method ..... **ASHRAE Standard 62.1-2016**
Unocc. Damper Position ..... **Closed**
Damper Leak Rate ..... **5** %

Economizer Data:

Control ..... **Integrated enthalpy control**
Upper Cutoff ..... **73.0** F
Lower Cutoff ..... **-60.0** F

Preheat Coil Data:

Setpoint ..... **52.0** F
Heating Source ..... **Electric Resistance**
Schedule ..... **JFMAMJJASOND**
Coil position ..... **Downstream of Mixing Point**

Central Cooling Data:

Supply Air Temperature ..... **55.0** F
Cooling Source ..... **Air-Cooled DX**
Schedule ..... **JFMAMJJASOND**
Capacity Control ..... **Constant Temperature - Fan On**

Supply Fan Data:

Fan Type ..... **Forward Curved with VFD**
Configuration ..... **Draw-thru**
Fan Performance ..... **2.00** in wg
Overall Efficiency ..... **54** %

% Airflow	100	90	80	70	60	50
% kW	100	77	60	44	35	25

% Airflow	40	30	20	10	0
% kW	19	13	9	7	6

Duct System Data:

Supply Duct Data:

Duct Leakage ..... **0** %

Return Duct or Plenum Data:

Return Air Via ..... **Ducted Return**

3. Zone Components:

Assigned Zones:

Zone	Zone Name
1	D101 - Classroom
2	D102 - Classroom
3	D103 - Classroom
4	D104 - Classroom
5	D105 - South Vestibule
6	D106 - Classroom
7	D107 - Classroom
8	D108 - Classroom
9	D112 - West Vestibule
10	D113 - West Corridor
11	D114 - South Corridor

Number of zones **11**

Thermostats and Zone Data:

Zone	Cooling T-Stat Occ. (F)	Cooling T-Stat Unocc. (F)	Heating T-Stat Occ. (F)	Heating T-Stat Unocc. (F)	T-Stat Throttling Range (F)	Diversity Factor (%)	Direct Exhaust Fan (kW)
1	75.0	80.0	70.0	65.0	1.50	100	0.0
2	75.0	80.0	70.0	65.0	1.50	100	0.0
3	75.0	80.0	70.0	65.0	1.50	100	0.0
4	75.0	80.0	70.0	65.0	1.50	100	0.0
5	75.0	80.0	70.0	65.0	1.50	100	0.0
6	75.0	80.0	70.0	65.0	1.50	100	0.0
7	75.0	80.0	70.0	65.0	1.50	100	0.0
8	75.0	80.0	70.0	65.0	1.50	100	0.0
9	75.0	80.0	70.0	65.0	1.50	100	0.0
10	75.0	80.0	70.0	65.0	1.50	100	0.0
11	75.0	80.0	70.0	65.0	1.50	100	0.0

Thermostat Schedule ..... **Fan / Thermostat**
Unoccupied Cooling is ..... **Available**

Supply Terminals Data:

Zone	Terminal Type	Air Distribution	Air Distribution Effectiveness Specification	Air Distribution Effectiveness	Minimum Airflow	Design Supply Temp.	Fan Perf.	Fan Efficiency
1	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
2	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
3	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
4	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
5	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
6	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
7	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
8	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
9	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
10	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-
11	VAV box with RH (Dual Maximum)	Ceiling supply / ceiling return	ASHRAE 62.1	<auto>	25 %	90.0 F	-	-

Reheat Coil Source ..... **Electric Resistance**
Reheat Coil Schedule ..... **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:

Cooling Supply Temperature ..... **55.0** F
Supply Fan Airflow ..... **6433.6** CFM
Ventilation Airflow ..... **3882.3** CFM

Hydronic Sizing Specifications:

Chilled Water Supply Temperature ..... **44.0** F
Chilled Water Delta-T ..... **10.0** F
Hot Water Supply Temperature ..... **140.0** F
Hot Water Delta-T ..... **20.0** F

Safety Factors:

Cooling Sensible ..... **0** %
Cooling Latent ..... **0** %
Heating ..... **0** %

Zone Sizing Data:

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

Zone	Supply Airflow (CFM)	Zone Htg Unit (MBH)	Reheat Coil (MBH)	FPMBX Fan (CFM)
1	741.3	-	16.8	-
2	724.1	-	16.5	-
3	748.8	-	16.9	-

Zone	Supply Airflow (CFM)	Zone Htg Unit (MBH)	Reheat Coil (MBH)	FPMBX Fan (CFM)
4	750.9	-	16.8	-
5	128.1	-	4.7	-
6	842.5	-	16.7	-
7	803.0	-	16.8	-
8	1470.1	-	34.2	-
9	136.7	-	5.0	-
10	270.4	-	3.5	-
11	253.6	-	3.2	-

5. Equipment Data

Central Cooling Unit - Air-Cooled DX

Estimated Maximum Load ..... **360.5** MBH
Design OADB ..... **95.0** F
Design EWB ..... **67.0** F
Equipment Sizing ..... **(Auto-Sized) 414.6** MBH
Capacity Oversizing Factor ..... **15** %
AHRI Performance Rating ..... **10.000** EER
DX System Configuration ..... **3-stage, 3 compressors, 2 circuits**
Low Temperature Cutoff OAT ..... **0.0** F

ALT1 - VAV RTU Input Data

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:20 PM

1. General Details:

Name ..... **ALT1 - VAV RTU**
Energy Sim. Status ..... **Calculated**

2. Plants Included in this Alternative:

(none)

3. Air Systems Included in this Alternative:

Air System	# Zones
VAV - Wing D	11

4. Space Models Included in this Alternative:

Summary Calculation Status:
Design Sizing ..... **Calculated**
Energy Simulation ..... **Calculated**

Space Model: School Wing D (for School Wing D)
Design Sizing ..... **Calculated**
Energy Simulation ..... **Calculated**

Zone	Air System
D101 - Classroom	VAV - Wing D
D102 - Classroom	VAV - Wing D
D103 - Classroom	VAV - Wing D
D104 - Classroom	VAV - Wing D
D105 - South Vestibule	VAV - Wing D
D106 - Classroom	VAV - Wing D
D107 - Classroom	VAV - Wing D
D108 - Classroom	VAV - Wing D
D112 - West Vestibule	VAV - Wing D
D113 - West Corridor	VAV - Wing D
D114 - South Corridor	VAV - Wing D

5. Miscellaneous Energy

(no items defined)

6. Meters

Electric ..... **Indiana - EIA 2020**

7. Miscellaneous Data

Average Building Power Factor ..... **100.00** %
Source Electric Generating Efficiency ..... **28.00** %
Additional Floor Area ..... **0.0** sqft

Schedule Input Data

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:21 PM

90.1 Office Lights/Elec (Fractional)

Hourly Profiles:

Design Day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	5

Weekday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	10	10	30	90	90	90	90	80	90	90	90	90	50	30	30	20	20	10	5

Saturday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	5	10	10	30	30	30	30	15	15	15	15	15	5	5	5	5	5	5	5

Sunday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	2	2	2	2	2	2	2	2	2	2	2	2
Tuesday	2	2	2	2	2	2	2	2	2	2	2	2
Wednesday	2	2	2	2	2	2	2	2	2	2	2	2
Thursday	2	2	2	2	2	2	2	2	2	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	3	3	3	3	3	3	2	3	3	3	3	3
Sunday	4	4	4	4	4	4	4	4	4	4	4	4
Holiday	4	4	4	4	4	4	4	4	4	4	4	4

90.1 Office Occupancy (Fractional)

Hourly Profiles:

Design Day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	0

Weekday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	10	20	95	95	95	95	50	95	95	95	95	30	10	10	10	10	5	5

Saturday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	10	10	30	30	30	30	10	10	10	10	10	5	5	0	0	0	0	0

Sunday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	5	5	5	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	2	2	2	2	2	2	2	2	2	2	2	2
Tuesday	2	2	2	2	2	2	2	2	2	2	2	2
Wednesday	2	2	2	2	2	2	2	2	2	2	2	2
Thursday	2	2	2	2	2	2	2	2	2	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	3	3	3	3	3	3	3	3	3	3	3	3
Sunday	4	4	4	4	4	4	4	4	4	4	4	4
Holiday	4	4	4	4	4	4	4	4	4	4	4	4

90.1 School Lights/Elec (Fractional)

Hourly Profiles:

Design Day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	5	5	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	5	5

Weekday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	5	5	30	85	95	95	95	80	80	80	70	50	50	35	35	35	30	5	5

Saturday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	5	5	5	15	15	15	15	15	5	5	5	5	5	5	5	5	5	5	5

Sunday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	2	2	2	2	2	2	2	2	2	2	2	2
Tuesday	2	2	2	2	2	2	2	2	2	2	2	2
Wednesday	2	2	2	2	2	2	2	2	2	2	2	2
Thursday	2	2	2	2	2	2	2	2	2	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	3	3	3	3	3	3	3	3	3	3	3	3
Sunday	4	4	4	4	4	4	4	4	4	4	4	4
Holiday	4	4	4	4	4	4	4	4	4	4	4	4

90.1 School Occupancy (Fractional)

Hourly Profiles:

Design Day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	0

Weekday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	5	75	90	90	80	80	80	80	45	15	5	15	20	20	10	0	0

Saturday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0

Sunday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	2	2	2	2	2	2	2	2	2	2	2	2
Tuesday	2	2	2	2	2	2	2	2	2	2	2	2
Wednesday	2	2	2	2	2	2	2	2	2	2	2	2
Thursday	2	2	2	2	2	2	2	2	2	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	3	3	3	3	3	3	3	3	3	3	3	3
Sunday	4	4	4	4	4	4	4	4	4	4	4	4
Holiday	4	4	4	4	4	4	4	4	4	4	4	4

Fan / Thermostat (Fan / Thermostat)

Hourly Profiles:

Design Day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	U	U	U	U	U	U	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	U	U

Weekday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	U	U	U	U	U	U	U	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	U	U

Saturday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	U	U	U	U	U	U	U	U	O	O	O	O	O	U	U	U	U	U	U	U	U	U	U	U

Sunday

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

O = Occupied; U = Unoccupied

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	2	2	2	2	2	2	2	2	2	2	2	2
Tuesday	2	2	2	2	2	2	2	2	2	2	2	2
Wednesday	2	2	2	2	2	2	2	2	2	2	2	2
Thursday	2	2	2	2	2	2	2	2	2	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	3	3	3	3	3	3	3	3	3	3	3	3
Sunday	4	4	4	4	4	4	4	4	4	4	4	4
Holiday	4	4	4	4	4	4	4	4	4	4	4	4

2016 Zone 4 Above-grade steel-framed wall

Wall Type ..... **Exterior, Above Grade Wall**
Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Medium**
Outside Absorptivity **0.675**
Overall U-Value ..... **0.064** BTU/(hr sqft F)

Wall Assembly Layers - (Inside Space to Outside)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Inside Surface Resistance				0.68000	
5/8-in gypsum board	0.625	50.0	0.26	0.56306	2.6
3.5-in cavity, 16-in o.c. steel frame, R-13 batt	3.500	3.4	0.20	6.00000	1.0
R-7.5 board insulation	1.500	2.5	0.35	7.50000	0.3
5/8-in gypsum board	0.625	50.0	0.26	0.56306	2.6
3/4-in HW stucco	0.750	120.0	0.20	0.08000	7.5
Outside Surface Resistance				0.17000	
Totals	**7.000**	**-**	**-**	**15.55612**	**14.0**

Interior Gypsum Board Wall

Wall Type ..... **Interior Wall**
Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Light**
Outside Absorptivity **0.450**
Overall U-Value ..... **0.305** BTU/(hr sqft F)

Wall Assembly Layers - (Inside Space to Outside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Inside Surface Resistance				0.68000	
5/8-in gypsum board	0.625	50.0	0.26	0.56306	2.6
3.5-in cavity, 16-in o.c. steel frame, no insul	3.500	2.9	0.01	0.79000	0.8
5/8-in gypsum board	0.625	50.0	0.26	0.56306	2.6
Outside Surface Resistance				0.68000	
Totals	**4.750**	**-**	**-**	**3.27612**	**6.0**

2016 Zone 4 Insulation entirely above deck

Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Medium**
Outside Absorptivity **0.675**
Overall U-Value ..... **0.032** BTU/(hr sqft F)

Roof Assembly Layers - (Outside to Inside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Outside Surface Resistance				0.17000	
R-30 board insulation	6.000	2.5	0.35	30.00000	1.3
22-gauge steel roof deck	0.034	489.0	0.12	0.00009	1.4
Inside Surface Resistance				0.61000	
Totals	**6.034**	**-**	**-**	**30.78009**	**2.6**

Ceiling Constructions

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:22 PM

Acoustic Tile Ceiling

Inside Surface Color ..... **Light**
Inside Absorptivity **0.450**
Outside Surface Color ..... **Light**
Outside Absorptivity **0.450**
Overall U-Value ..... **0.350** BTU/(hr sqft F)

Ceiling Assembly Layers - (Outside Space to Inside Space)

Layers	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
Outside Surface Resistance				0.46000	
Acoustic Tile	0.750	23.0	0.14	1.78571	1.4
Inside Surface Resistance				0.61000	
Totals	**0.750**	**-**	**-**	**2.85571**	**1.4**

2016 Zone 4 Slab-on-grade floor, unheated

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

Floor Assembly Layers - (Inside Space to Soil)

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

Exterior Insulation

Configuration ..... **Horizontal Exterior Insulation**
Horizontal Insulation Extends Inward from Slab Perimeter ..... **2.00** ft

Exterior Insulation Layer	Thickness in	Density lb/cuft	Specific Heat BTU / (lb F)	R-Value (hr sqft F)/BTU	Weight lb/sqft
R-15 board insulation	3.000	2.5	0.35	15.00000	0.6

Window Constructions

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:23 PM

2016 Zone 4 Metal framing, fixed

Input Method ..... **Simple input method**

Window Performance:

Overall U-Value	**0.380**	BTU/(hr sqft F)
Overall SHGC	**0.360**	
Overall VT	**0.396**	

Internal Shade:

Type ..... **None**

Door Constructions

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:23 PM

2016 Zone 4 Glass, metal framing, entrance door

Door Type	**Glass Door**	
Glass U-Value	**0.680**	BTU/(hr sqft F)
Glass SHGC	**0.360**	
Glass VT	**0.396**	

Exterior Shades

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:23 PM

Entrance Porch Roof Overhang

Reveal Depth..... **0.0** in

Overhang:
- Projection from surface ..... **72.0** in
- Height above window..... **12.0** in
- Ext. past RH side of window..... **12.0** in
- Ext. past LH side of window ..... **12.0** in

Left Fin:
- Projection from surface..... **0.0** in
- Height above window ..... **0.0** in
- Dist. from edge of window ..... **0.0** in

Right Fin:
- Projection from surface ..... **0.0** in
- Height above window..... **0.0** in
- Dist. from edge of window..... **0.0** in

Electric Rate Input Data

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:23 PM

Indiana - EIA 2020

General Details

Rate Name ..... **Indiana - EIA 2020**
Rate Type ..... **Complex**
Energy Units ..... **kWh**
Conversion ..... **1.00000** kWh/kWh
Demand Units ..... **kW**
Customer Charge ..... **0.00** $
Minimum Charge ..... **0.00** $
Tax Rate ..... **0.00** %

Emissions Analysis

CO2e Factor ..... **1.67** lb/kWh

Energy Charges

Type of Energy Charge ..... **Standard**

Step Type	Season	Period	Block Size	Block Units	$/kWh
Energy	All Seasons	All Periods	9999999	kWh	0.11210

Demand Clauses

No data specified. .....

Fuel Rate Input Data

Project: 860-HAP60-Example-Problem 11/21/2022
Prepared by: Carrier 3:24 PM

Indiana - EIA 2020

General Details

Rate Name	**Indiana - EIA 2020**	
Rate Type	**Simple**	
Energy Units	**MCF**	
Conversion	**1000.00000**	kBTU/MCF
Demand Units	**Hourly Peak**	
Flat Price	**6.86000**	$/MCF
Customer Charge	**0.00**	$
Minimum Charge	**0.00**	$
Tax Rate	**0.00**	%

Emissions Analysis

CO2e Factor	**123.00**	lb/MCF