

EXchange



HAP v6 – Visual Take-Offs for Enhanced Productivity

This is the second in a series of articles describing key features in the upcoming HAP v6 release. In the first article ([Volume 5, Issue 3](#)) we described the rationale for transforming HAP, the “staged” approach designed to help you remain productive as the software evolves, and the key features in the first staged release. The subject of this article is one of these key features — a “visual” take-off process that uses graphical input of building floor plans to enhance your productivity. Future articles in this series will explain the new state of the art load calculations and building simulations, how we’ve designed the releases to ensure you can maintain productivity with the software as it evolves, and other enhancements to the software

One goal of HAP v6 is to significantly reduce labor for the floor plan take-off process. Defining rooms in the building floor plan is the most labor-intensive task in assembling a building model for peak load calculation or energy modeling. In the past this involved printed architectural floor plans, a pencil, a ruler, and a calculator to take off lengths and widths of rooms and then manually compute the areas of floors, walls, windows and roofs. More recently a variety of software tools have been employed to automate the scaling of lengths and widths from electronic drawings and the calculation of areas. But all of these areas must still be manually entered as tabular data into a load calculation or energy modeling tool. This article will provide a high-level overview of
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how HAP v6 is being designed to reduce labor for take-offs and enhance your productivity in assembling building models.

Before we go any further, however, we should pause to put to rest any concerns. While talking with customers about these new features, we sometimes hear concerns that features for tracing floor plans might be technically complex, difficult to master, and a barrier to using the software. It's critical to stress up front that the graphical input of building floor plans in HAP v6:

- Is not computer aided drafting (CAD) or building information modeling (BIM).
- Will not require extensive training and expertise to master such as CAD or BIM require.
- Will not require special computer hardware or require special devices such as light pens.

Instead, the HAP v6 floor plan drawing features:

- Will be very light-weight, simple, intuitive, point-and-click drawing features that can be mastered in a few minutes.
- Will run on any computer you're currently using to run HAP.

Now let's look at how the drawing features work.

First, it's important to note HAP will support various applications involving schematic design, detailed design, new construction, and existing building renovation. One scenario that is very common and useful for a high-level

explanation is a new construction project where you have architectural two-dimensional floor plan drawings in a format such as a PDF file. With this scenario, graphically defining the floor plan has these steps:

1. Import the floor plan PDF into HAP. Establish the scale so HAP can relate distance in the drawing to actual distance in feet, inches, meters, or centimeters.
2. Trace the outlines of rooms, drawing lines with a few simple clicks of your mouse. Think of this as tracing on a transparent overlay placed on top of the floor plan image.
3. Place the locations of windows and doors in exterior walls by dragging and dropping from window and door libraries.
4. Specify the floor to floor height to allow the software to "extrude" the floor plan into a three dimensional building model.
5. With this data HAP will automatically calculate areas and orientations of floors, walls, windows, doors, skylights, ceilings, and roofs for each room. You will not need to manually enter those areas and orientations.
6. In addition, HAP will display a three-dimensional view of the building exterior to allow visualization and inspection of your building model.
7. Finally, add information such as envelope assemblies, internal heat gains and schedules, ventilation and exhaust airflow requirements, and infiltration to complete the space definitions.

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Looking more closely at how the tracing of room outlines works, think of this first as two basic kinds tools for tracing:

1. Rectangular Rooms: If you have a room that's a rectangle, you simply click opposite corners of the room to establish its outline (Figures 1a and 1b). That's all it takes to define the room outline.

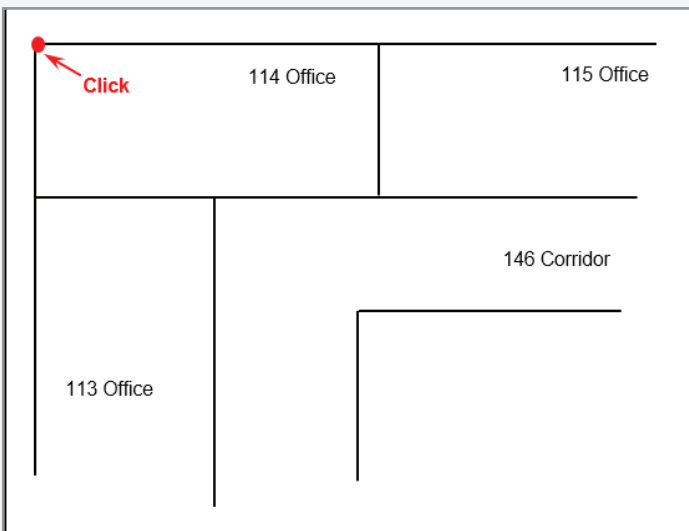


Figure 1a. Click Corner of Room

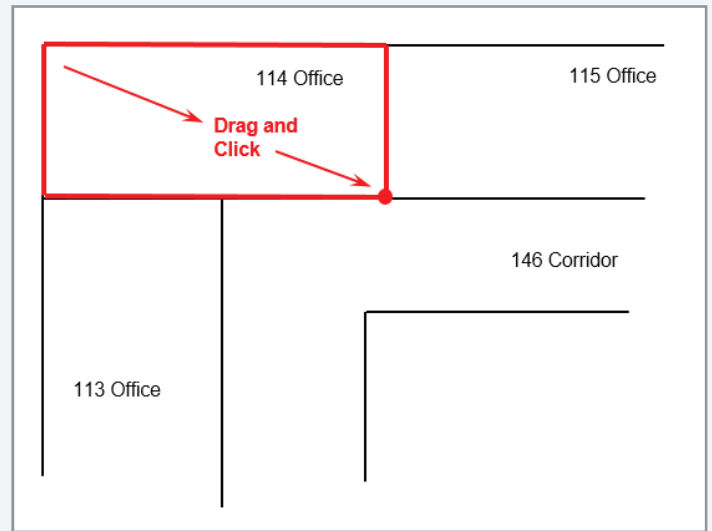


Figure 1b. Drag Mouse Cursor and Click Opposite Corner

2. Non-Rectangular Rooms - If you have a room that's not a rectangle, point and click the corners of the room in succession until the outline is complete (Figures 2a and 2b).

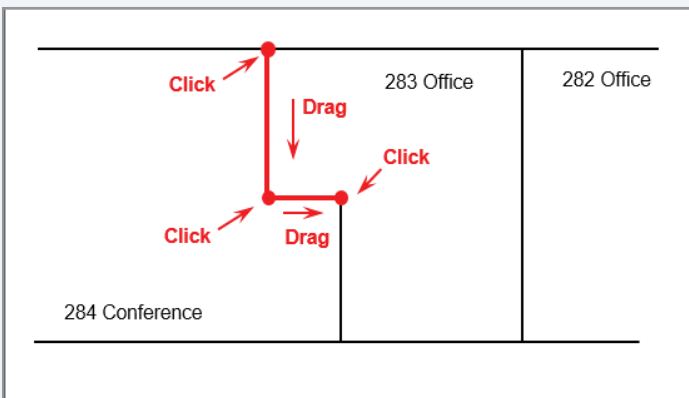


Figure 2a. Click, Drag, Click Each Wall Segment

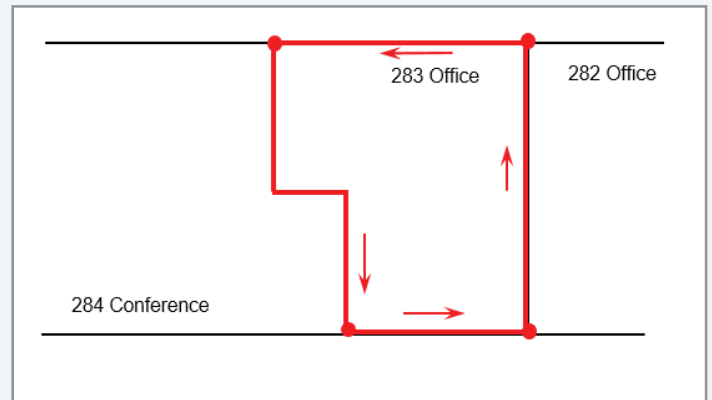


Figure 2b. Drag and Click Remaining Wall Segments

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While these two approaches are fast and efficient, they require tracing room outlines one by one. HAP will also provide a third approach that doesn't require one-by-one room tracing. This makes tracing floor plans even faster. With this approach:

1. Point and click to define the line segments comprising the exterior walls of the floor (Figure 3a, item 1).
2. Now trace individual walls within the floor plan. For example, lines might trace the wall along the entire length of a corridor. Figure 3a lines 2 and 3 show two walls of corridors added to the tracing.
3. Then as you trace the individual side walls of a room (Figure 3b, lines 4 and 5), HAP detects when you

complete a new enclosed areas. HAP identifies each new area as a space (Figure 3b, orange shaded area).

4. Drawing another side wall (Figure 3b line 6) encloses further areas which are identified as rooms (Figure 3b, blue and purple shaded areas).
5. The process continues until all rooms in the floor plan have been defined.

In this way you can minimize the number of line segments you trace in the floor plan. You arrive at the same final floor plan definition as if you traced each room one by one, but with much less time and effort.

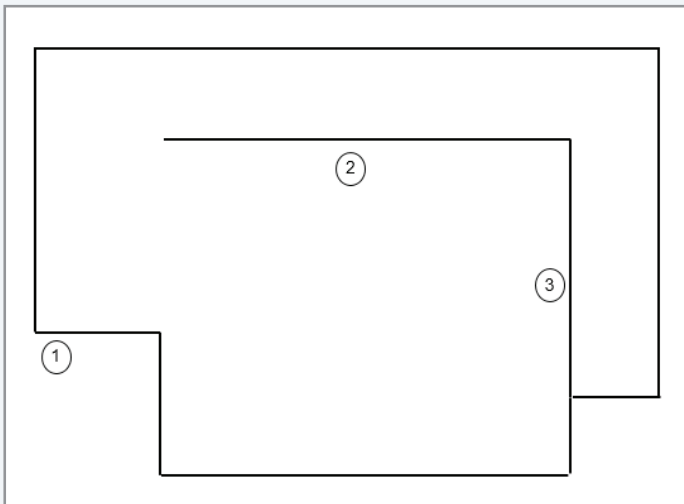


Figure 3a. Trace Ext Walls (1); Draw Interior Walls (2, 3)

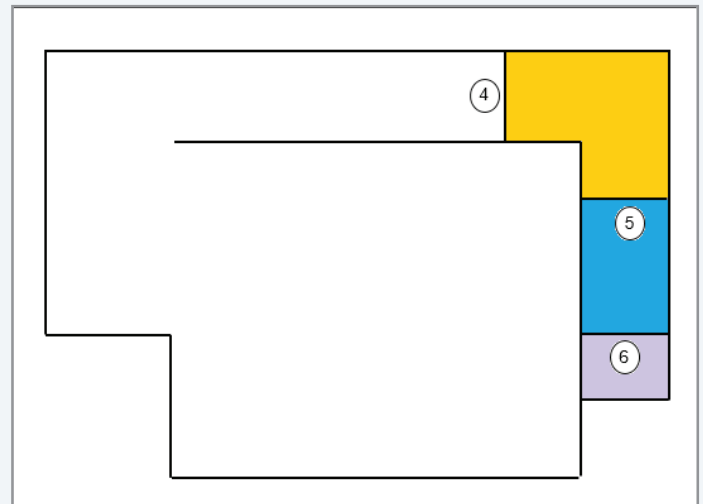


Figure 3b. Trace Room Side Walls; Rooms Auto-Identified

In addition to the drawing features described above, HAP will offer:

- Free form drawing of floor plans. In this case the rectangle, non-rectangle, and line drawing features above are used on a blank "drawing canvas". This can be useful for rapidly defining the building for block load applications early in a project, and for situations where detailed architectural floor plans are not available.
- The Building Wizard feature for rapid generation of building floor plans in the schematic design phase of projects.

- Green Building XML (gbXML) import so floor plan data can be imported directly from building information modeling tools, eliminating the need to draw or trace over a floor plan image.

Full details of the drawing features will be provided in software documentation, examples, tutorials, and the roll-out training planned to accompany HAP v6 release. If you have comments or suggestions on this feature, please contact us at software.systems@carrier.utc.com Attn: HAP v6 Comments.

Utilizing HAP Diagnostics Reports to Verify System Design Results

Most HAP users are very familiar with the standard, default system design & sizing reports. However, many users may not be aware that there are other diagnostic reports available which contain much more detailed information. An argument could be made that users should *always* review these diagnostics reports to verify the integrity of the calculated design load results. A future *EXchange* article will discuss how to verify Hourly System Simulation (operating cost) results; however, this article focuses exclusively on diagnosing system design load results.

Diagnostics reports are very useful for troubleshooting, like peeling back the layers of an onion, to observe detailed data such as component loads (how much of my total cooling load is from the building envelope, solar, internal loads and ventilation)? Or what time of year does

the cooling load peak for the southeast facing space? How does the ventilation load vary over the design day and throughout the year? What is the latent load or zone temperature and relative humidity during off-peak times? How much fan heat is there or what temperature is the return plenum during wintertime? All these and many more detailed results may be explored by looking at the various diagnostics reports. This topic will highlight some of the diagnostics reports capabilities in HAP.

Before we delve into the diagnostics let's review the basics. The top portion of the System Design Reports selection dialog box is specifically labelled, "Sizing Reports" (Figure 1). These three reports include the *Air System Sizing Summary*, *Zone Sizing Summary* and *Ventilation Sizing Summary*.

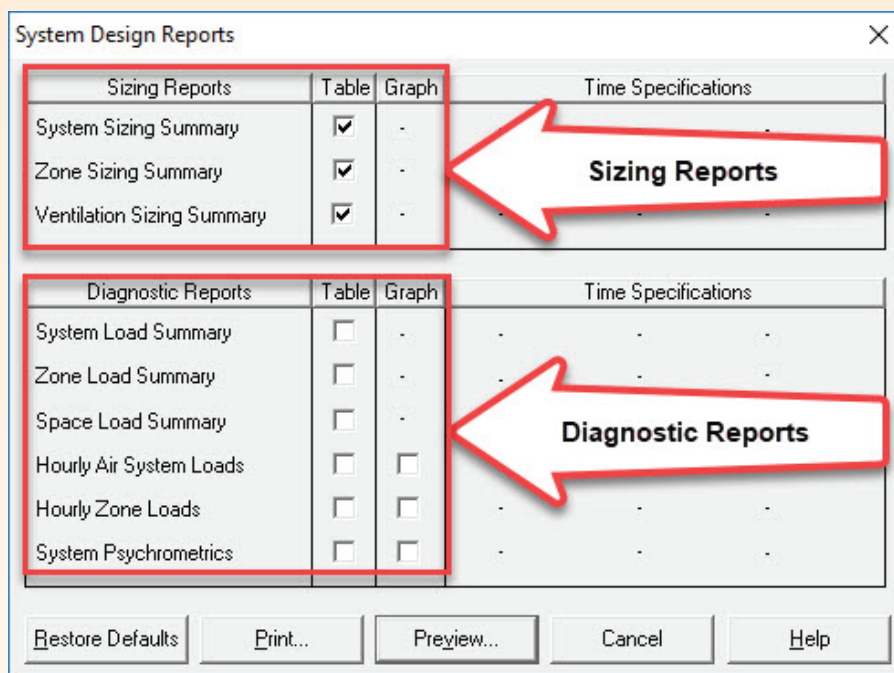


Figure 1. Design Load Sizing & Diagnostic Reports

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The *Air System Sizing Summary* report (Figure 2) is a summary of the calculated design load at the peak load condition, a snapshot in time if you will.

Air System Sizing Summary for Pkg RTU			
Project Name: RTU Office		05/16/2018	
Prepared by: Carrier		01:55PM	
Air System Information			
Air System Name	Pkg RTU	Number of zones	1
Equipment Class	PKG ROOF	Floor Area	15000.0 ft ²
Air System Type	SZCAV	Location	Dallas, Texas
Sizing Calculation Information			
Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads
Central Cooling Coil Sizing Data			
Total coil load	37.7 Tons	Load occurs at	Jul 1600
Total coil load	452.7 MBH	OA DB / WB	100.0 / 74.0 °F
Sensible coil load	365.8 MBH	Entering DB / WB	78.6 / 64.7 °F
Coil CFM at Jul 1600	15033 CFM	Leaving DB / WB	55.6 / 54.3 °F
Max block CFM	15033 CFM	Coil ADP	53.1 °F
Sum of peak zone CFM	15033 CFM	Bypass Factor	0.100
Sensible heat ratio	0.808	Resulting RH	50 %
CFM/Ton	398.5	Design supply temp.	58.0 °F
ft ² /Ton	397.6	Zone T-stat Check	1 of 1 OK
BTU/(hr-ft ²)	30.2	Max zone temperature deviation	0.0 °F
Water flow @ 10.0 °F rise	N/A		
Central Heating Coil Sizing Data			
Max coil load	188.0 MBH	Load occurs at	Des Htg
Coil CFM at Des Htg	15033 CFM	BTU/(hr-ft ²)	12.5
Max coil CFM	15033 CFM	Ent. DB / Lvg DB	64.4 / 76.2 °F
Water flow @ 20.0 °F drop	N/A		
Supply Fan Sizing Data			
Actual max CFM	15033 CFM	Fan motor BHP	8.23 BHP
Standard CFM	14711 CFM	Fan motor kW	6.53 kW
Actual max CFM/ft ²	1.00 CFM/ft ²	Fan static	2.00 in wg
Outdoor Ventilation Air Data			
Design airflow CFM	1463 CFM	CFM/person	19.50 CFM/person
CFM/ft ²	0.10 CFM/ft ²		

Figure 2. Air System Sizing Summary Report – Pkg RTU System

It shows the central system load sizing results including the peak cooling and heating loads, required airflow quantities for supply air and ventilation air, the peak time the cooling load occurs as well as useful information such as resulting relative humidity (RH), coil selection parameters and engineering check figures such as sensible heat ratio (SHR), supply and ventilation airflow CFM/sq ft as well as total floor area and total number of

occupants. Not only will these numbers provide an overall summary of the building (total cooling tons, total floor area and number of occupants) these numbers will also tell you if there are potential design challenges such as very high or low resulting RH or airflow (CFM/ton) that is outside the normal selection range for typical HVAC equipment (also see earlier [EXchange Vol 2, Issue 2](#) article, "Interpreting High (Low) Peak Design Airflow

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Sizing Results for HVAC Equipment Selection, for additional information. For example, if the calculated SHR is very low, meaning the latent load is very large, this could indicate that you might need to apply special system controls and components such as active dehumidification, ventilation air heat reclaim or require equipment operation outside the normal conditions for typical packaged units. Similarly, if the ventilation air quantity is much over 30-40% of total supply air quantity additional components such as hi-capacity

coils or preconditioning of the ventilation air may be required in order to use a DX packaged unit.

If you are designing a Terminal Unit system (such as VRF, WSHP, 2-pipe FCU for example), and are using a Dedicated Outdoor Air System (DOAS), then the *Air System Sizing Summary* report will contain the sizing results for the DOAS-only, this is because there is no central system with terminal units (Figure 3).

Dedicated Outdoor Air System (DOAS) Sizing Summary for VRF			
Project Name: VRF Office		02/26/2018	
Prepared by: Carrier		10:17AM	
Air System Information			
Air System Name	VRF	Number of zones	5
Equipment Class	TERM	Floor Area	15000.0 ft²
Air System Type	VRF	Location	Dallas, Texas
Sizing Calculation Information			
Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads
Cooling Coil Sizing Data			
Total coil load	6.9 Tons	Load occurs at	Jul 1600
Total coil load	83.4 MBH	OA DB / WB	100.0 / 74.0 °F
Total coil load	210.5 CFM/Ton	Entering DB / WB	100.0 / 74.0 °F
Sensible coil load	63.5 MBH	Leaving DB / WB	58.9 / 56.7 °F
Coil CFM at Jul 1600	1463 CFM	Bypass Factor	0.100
Max coil CFM	1463 CFM		
Sensible heat ratio	0.761		
Water flow @ 10.0 °F rise	N/A		
Heating Coil Sizing Data			
Max coil load	57.1 MBH	Load occurs at	Des Htg
Coil CFM at Des Htg	1463 CFM	Ent. DB / Lvg DB	17.0 / 53.9 °F
Max coil CFM	1463 CFM		
Water flow @ 20.0 °F drop	N/A		
Ventilation Fan Sizing Data			
Actual max CFM	1463 CFM	Fan motor BHP	0.60 BHP
Standard CFM	1431 CFM	Fan motor kW	0.48 kW
Actual max CFM/ft²	0.10 CFM/ft²	Fan static	1.50 in wg
Exhaust Fan Sizing Data			
Actual max CFM	1463 CFM	Fan motor BHP	0.40 BHP
Standard CFM	1431 CFM	Fan motor kW	0.32 kW
Actual max CFM/ft²	0.10 CFM/ft²	Fan static	1.00 in wg
Outdoor Ventilation Air Data			
Design airflow CFM	1463 CFM	CFM/person	19.50 CFM/person
CFM/ft²	0.10 CFM/ft²		

Figure 3. DOAS Sizing Summary Report – Terminal Unit Systems

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If designing a terminal unit system, you will also need to refer to the *Zone Sizing Summary* report (Figure 4), which lists terminal unit sizing data such as peak zone cooling and heating loads, airflows, entering and leaving coil conditions, time of peak coil load, zone CFM/sq ft and ventilation CFM per zone. If designing a VRF system, the

outdoor unit sizing criteria will also be included on this report. Problem zones might indicate a high zone CFM/sq ft, such as > 2.0 CFM/sq ft, which may identify special application requirements such as colder supply air might be needed.

Zone Sizing Summary for VRF							
Project Name: VRF Office Prepared by: Carrier						02/26/2018 10:17AM	
Air System Information							
Air System Name		VRF		Number of zones		5	
Equipment Class		TERM		Floor Area		15000.0 ft²	
Air System Type		VRF		Location		Dallas, Texas	
Sizing Calculation Information							
Calculation Months		Jan to Dec		Zone CFM Sizing		Sum of space airflow rates	
Sizing Data		Calculated		Space CFM Sizing		Individual peak space loads	
Terminal Unit Sizing Data - Cooling							
Zone Name	Total Coil Load (MBH)	Sens Coil Load (MBH)	Coil Entering DB / WB (°F)	Coil Leaving DB / WB (°F)	Water Flow @ 10.0 °F (gpm)	Time of Peak Coil Load	Zone CFM/ft²
BLD1-F001-Z01	36.3	35.0	75.1 / 63.7	58.8 / 57.7	-	Jun 1800	1.00
BLD1-F001-Z02	33.6	32.2	75.6 / 63.4	58.0 / 56.8	-	Jul 1000	1.36
BLD1-F001-Z03	52.4	50.7	75.5 / 63.8	58.8 / 57.7	-	Oct 1600	1.42
BLD1-F001-Z04	36.6	35.8	75.9 / 64.3	59.5 / 58.4	-	Jul 1800	1.63
BLD1-F001-Z05	101.7	92.8	75.1 / 63.6	58.0 / 56.9	-	Jul 0600	0.61
Terminal Unit Sizing Data - Heating, Fan, Ventilation							
Zone Name	Heating Coil Load (MBH)	Heating Coil Ent/Lvg DB (°F)	Htg Coil Water Flow @20.0 °F (gpm)	Fan Design Airflow (CFM)	Fan Motor (BHP)	Fan Motor (kW)	OA Vent Design Airflow (CFM)
BLD1-F001-Z01	28.8	68.3 / 81.7	-	2033	0.301	0.238	197
BLD1-F001-Z02	19.6	69.1 / 79.7	-	1734	0.256	0.203	124
BLD1-F001-Z03	29.2	69.0 / 78.6	-	2872	0.425	0.337	197
BLD1-F001-Z04	18.2	68.9 / 77.2	-	2073	0.307	0.243	124
BLD1-F001-Z05	51.9	67.8 / 77.3	-	5152	0.762	0.604	819
VRF Outdoor Unit Sizing Data							
	Cooling [MBH]	Cooling [Tons]	Heating [MBH]				
Peak Coincident Indoor Unit Loads	221.8	18.5	147.8				
Estimated Piping / Line Losses	19.0	1.6	3.9				
Total Required ODU Capacity	240.8	20.1	151.7				
<small>Note: VRF piping / line losses are based on typical loss factors for this class of equipment. Actual line loss varies widely from one product to another. Therefore, when selecting equipment it is critical to consult manufacturer's guidance to utilize actual line loss data.</small>							
Zone Peak Sensible Loads							
Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)			
BLD1-F001-Z01	36.5	Jun 1900	27.3	2025.0			
BLD1-F001-Z02	31.2	Jul 1100	17.8	1275.0			
BLD1-F001-Z03	51.6	Oct 1500	27.3	2025.0			
BLD1-F001-Z04	37.3	Jul 1800	17.8	1275.0			
BLD1-F001-Z05	92.6	Jul 1900	40.5	8400.0			

Figure 4. Zone Sizing Summary Report – Terminal Unit Systems

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The *Zone Sizing Summary* report is also essential for verifying proper zoning choices. If the zone is comprised of multiple spaces you should review the space peak load times and compare them to the zone peak load time. If some of the spaces exhibit peak load times much different than the time the zone peaks this can indicate a possible control or comfort problem. This is demonstrated in Figure 5 below. Notice the zone peaks late in the day in July, 1800 hrs yet the "E" space peaks in July at 1100 hrs and the "SE" & "SW" spaces peak in the fall

at September 1500 & 1700 hrs, respectively. If those "rogue" spaces are on the same control zone as the other spaces which peak late in the day during summer, this will most likely result in uncomfortable occupants in those spaces. In this case those spaces should either be assigned to another new zone with a separate thermostat or combined in such a way that they can be controlled properly. It is important to understand load diversity and how various spaces/zones may each have unique load requirements.

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	231.3	Jul 1800	130.5	15000.0

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							
Core	1	92.6	Jul 1900	5152	40.5	8400.0	0.61
E	1	23.2	Jul 1100	1294	13.3	1050.0	1.23
N	1	31.2	Jun 1900	1735	22.8	1800.0	0.96
NE	1	6.2	Jul 1600	343	4.4	225.0	1.52
NW	1	7.4	Jul 1800	410	4.4	225.0	1.82
S	1	42.7	Oct 1500	2377	22.8	1800.0	1.32
SE	1	7.2	Sep 1500	401	4.4	225.0	1.78
SW	1	8.0	Sep 1700	447	4.4	225.0	1.99
W	1	27.8	Jul 1800	1547	13.3	1050.0	1.47

Figure 5. Zone Sizing Summary Report – Zone Peak versus Coincident Space Peak Loads

The *Ventilation Sizing Summary* report contains the calculation results for the total required ventilation air quantity and will not be discussed here. A separate article that focusses just on the ventilation report will be in a future *EXchange* as the ventilation report merits separate treatment.

The first diagnostic report is the *System Load Summary* (Figure 6). This is a very useful report for quantifying the component loads that comprise the total coil load indicated on the *Air System Sizing Summary*.

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Air System Design Load Summary for VRF						
Project Name: VRF Office Prepared by: Carrier			02/26/2018 10:22AM			
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 100.0 °F / 74.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 17.0 °F / 13.9 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1200 ft²	43288	-	1200 ft²	-	-
Wall Transmission	4800 ft²	7812	-	4800 ft²	11957	-
Roof Transmission	15000 ft²	58954	-	15000 ft²	72345	-
Window Transmission	1200 ft²	14100	-	1200 ft²	34980	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	15000 ft²	0	-	15000 ft²	11366	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	12300 W	41967	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	11250 W	38385	-	0	0	-
People	75	18375	15375	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	222880	15375	-	130648	0
Zone Conditioning	-	241426	15375	-	130726	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	1828 CFM	1355	-	1828 CFM	-1355	-
Ventilation Load	1828 CFM	44428	16011	1828 CFM	103032	0
Ventilation Fan Load	1828 CFM	2033	-	1828 CFM	-2033	-
Space Fan Coil Fans	-	5550	-	-	-5550	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	294792	31386	-	224820	0
Cooling Coil	-	79319	24911	-	0	0
Heating Coil	-	0	-	-	71389	-
Terminal Unit Cooling	-	215536	6968	-	0	0
Terminal Unit Heating	-	0	-	-	153431	-
>> Total Conditioning	-	294855	31879	-	224820	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Figure 6. Air System Design Load Summary Report

This report provides a summary of the component zone loads along with their details such as total window, wall, roof & floor areas, providing a quick check to ensure you didn't enter something incorrectly. Both sensible and latent load components are shown allowing you to easily determine where the total loads come from. For example, in Figure 6, the largest zone load is the roof transmission load at 58,954 BTU/hr. Quantifying the component loads

allows you to strategize about ways you might reduce these loads; add more roof insulation or change the roof color, for instance. Window and solar loads are also one of the larger component cooling loads at 43,288 BTU/hr. Perhaps you could change the glass type or add internal or external shading devices to reduce these loads further? This is the sort of thought process you should be aware of when reviewing the system load results.

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Next report is the *Zone Design Load Summary* (Figure 7). Essentially the same report as the *System Design Load Summary*, however at the zone-level.

Zone Design Load Summary for VRF						
Project Name: VRF Office Prepared by: Carrier				05/16/2018 02:42PM		
North Zone	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jun 1900			HEATING DATA AT DES HTG		
	COOLING OA DB / WB 92.7 °F / 70.8 °F			HEATING OA DB / WB 17.0 °F / 13.9 °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	360 ft²	9363	-	360 ft²	-	-
Wall Transmission	1440 ft²	2011	-	1440 ft²	3587	-
Roof Transmission	2025 ft²	8639	-	2025 ft²	9767	-
Window Transmission	360 ft²	3183	-	360 ft²	10494	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	2025 ft²	0	-	2025 ft²	3448	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	1661 W	5666	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1519 W	5182	-	0	0	-
People	10	2481	2076	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	36524	2076	-	27295	0

Figure 7. Zone Design Load Summary Report

The next diagnostic report is the *Space Design Load Summary* report, not shown. Essentially the same report as the *Zone Design Load Summary*, however at the space-level. Very useful for quantifying space-level component loads when multiple spaces are included in a zone or system.

(Continued from page 11)

The *Hourly Air System Loads* report (Figure 8) contains a 24-hr profile of the design month loads, in this case July. Note that the hourly ambient temperature is shown along with the supply airflow and hourly system coil loads for cooling and heating.

Project Name: VRF O'ffice

Prepared by: Carrier

02/26/2018
11:50AM

Hourly Air System Design Day Loads for VRF

DESIGN MONTH: JULY

Hour	OA TEMP (°F)	DOAS AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	VENT COOLING COIL (MBH)	VENT HEATING COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZONE HEATING UNIT (MBH)
0000	84.6	0	0.0	0.0	0.0	0.0	0.0	124.5	0.0	0.0
0100	83.4	0	0.0	0.0	0.0	0.0	0.0	127.7	0.0	0.0
0200	82.3	0	0.0	0.0	0.0	0.0	0.0	130.4	0.0	0.0
0300	81.3	0	0.0	0.0	0.0	0.0	0.0	132.2	0.0	0.0
0400	80.5	0	0.0	0.0	0.0	0.0	0.0	133.6	0.0	0.0
0500	79.9	0	0.0	0.0	0.0	0.0	0.0	134.5	0.0	0.0
0600	79.7	1828	0.0	0.0	0.0	58.9	0.0	208.2	0.0	0.0
0700	80.1	1828	0.0	0.0	0.0	59.8	0.0	208.6	0.0	0.0
0800	81.1	1828	0.0	0.0	0.0	62.1	0.0	207.8	0.0	0.0
0900	82.9	1828	0.0	0.0	0.0	66.2	0.0	207.7	0.0	0.0
1000	85.6	1828	0.0	0.0	0.0	72.1	0.0	205.5	0.0	0.0
1100	88.6	1828	0.0	0.0	0.0	78.9	0.0	203.3	0.0	0.0
1200	92.1	1828	0.0	0.0	0.0	86.6	0.0	201.7	0.0	0.0
1300	95.3	1828	0.0	0.0	0.0	93.8	0.0	207.6	0.0	0.0
1400	97.8	1828	0.0	0.0	0.0	99.3	0.0	211.3	0.0	0.0
1500	99.4	1828	0.0	0.0	0.0	102.9	0.0	216.6	0.0	0.0
1600	100.0	1828	0.0	0.0	0.0	104.2	0.0	222.5	0.0	0.0
1700	99.4	1828	0.0	0.0	0.0	102.9	0.0	216.5	0.0	0.0
1800	98.0	1828	0.0	0.0	0.0	99.7	0.0	220.4	0.0	0.0
1900	95.7	1828	0.0	0.0	0.0	94.8	0.0	215.8	0.0	0.0
2000	93.1	1828	0.0	0.0	0.0	88.9	0.0	207.9	0.0	0.0
2100	90.5	1828	0.0	0.0	0.0	83.0	0.0	201.9	0.0	0.0
2200	88.2	0	0.0	0.0	0.0	0.0	0.0	110.5	0.0	0.0
2300	86.2	0	0.0	0.0	0.0	0.0	0.0	120.4	0.0	0.0

Figure 8. Hourly Air System Design Day Loads Report



(Continued on page 13)

(Continued from page 12)

A similar report exists at the zone level, the Hourly Zone Load report (Figure 9). In addition to ambient temperature the zone temperature and zone relative humidity is indicated for each hour; especially useful for identifying possible temperature/humidity control issues not only during peak load times but at other times of the year at part-load conditions.

Project Name: VRF Office

Prepared by: Carrier

02/26/2018
12:01PM

ZONE: North Zone

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	84.6	80.5	45	698.1	29384.9	16596.7	18932.5	0.0	0.0
0100	83.4	80.5	45	708.5	28324.6	16848.4	19202.8	0.0	0.0
0200	82.3	80.5	45	715.6	27348.7	17022.6	19377.0	0.0	0.0
0300	81.3	80.5	45	719.2	26425.2	17109.6	19464.1	0.0	0.0
0400	80.5	80.5	45	720.6	25574.3	17143.8	19498.2	0.0	0.0
0500	79.9	80.5	45	720.2	24789.8	17134.3	19488.7	0.0	0.0
0600	79.7	76.4	56	2032.8	24096.7	33823.6	31280.1	0.0	0.0
0700	80.1	76.2	56	2032.8	25523.7	34067.0	31717.8	0.0	0.0
0800	81.1	76.3	57	2032.8	25987.8	33162.8	30542.1	0.0	0.0
0900	82.9	76.0	57	2032.8	26112.5	33325.9	30819.2	0.0	0.0
1000	85.6	76.3	58	2032.8	27117.8	32353.3	29414.4	0.0	0.0
1100	88.6	76.5	58	2032.8	28421.0	32046.6	28706.1	0.0	0.0
1200	92.1	76.4	57	2032.8	29879.8	33195.6	30067.1	0.0	0.0
1300	95.3	76.2	55	2032.8	31347.3	35240.5	32603.2	0.0	0.0
1400	97.8	76.4	55	2032.8	32793.1	35272.9	32426.5	0.0	0.0
1500	99.4	76.2	53	2032.8	34028.0	36725.7	34331.7	0.0	0.0
1600	100.0	76.2	53	2032.8	34957.0	37056.8	34718.2	0.0	0.0
1700	99.4	76.2	53	2032.8	35506.6	37423.5	35156.1	0.0	0.0
1800	98.0	76.3	53	2032.8	36290.4	37528.6	35279.6	0.0	0.0
1900	95.7	76.4	53	2032.8	36387.1	37004.4	34655.1	0.0	0.0
2000	93.1	76.1	54	2032.8	34020.2	35873.1	33609.4	0.0	0.0
2100	90.5	76.2	56	2032.8	33011.4	33762.6	30973.9	0.0	0.0
2200	88.2	80.4	46	635.9	31810.1	15086.7	17403.7	0.0	0.0
2300	86.2	80.5	45	683.1	30557.0	16231.4	18567.1	0.0	0.0

Figure 9. Hourly Zone Loads Report

(Continued from page 13)

This report may also be graphed (Figure 10) which is useful for observing trends, peaks or spikes, and especially for identifying pull-down or warm-up loads.

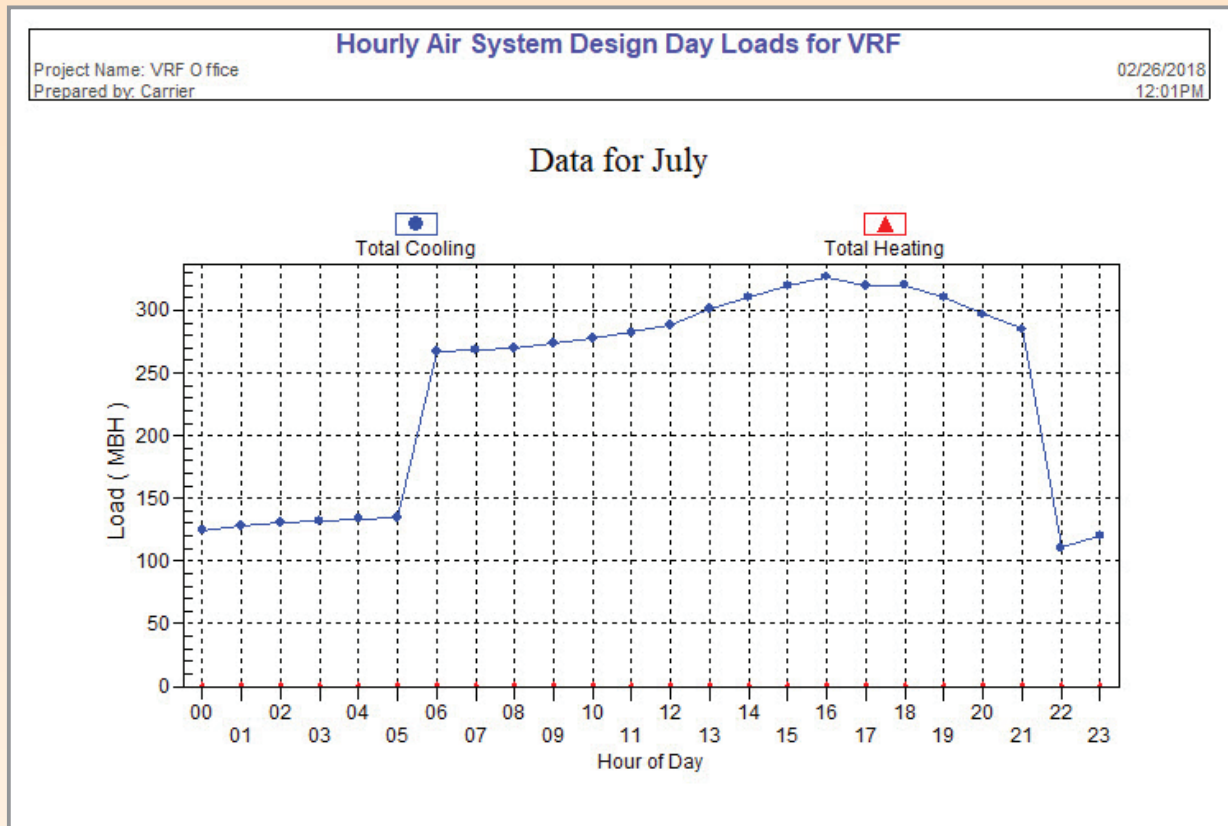


Figure 10. Hourly Zone Loads Graph - July

And finally, the *System Psychrometrics* report (Figure 11) indicates the psychrometric state-points of the air at all points in the system as well as at the zone-level. This is one of the most important reports to review, so even though it is placed at the bottom of the report selection dialog box it should not be neglected. A separate cooling and heating psychrometric report is generated, and indicates the zone dry-bulb temperature, specific humidity,

airflow, CO2 level, sensible and latent zone loads. This report helps diagnose system performance of components such as preheat or preheat coils (if present), central cooling and heating coils, supply and return fan heat, zone air and return duct or plenum temperatures. Note that it also displays the air constant used in the calculations, which is specific to the site altitude.

(Continued from page 14)

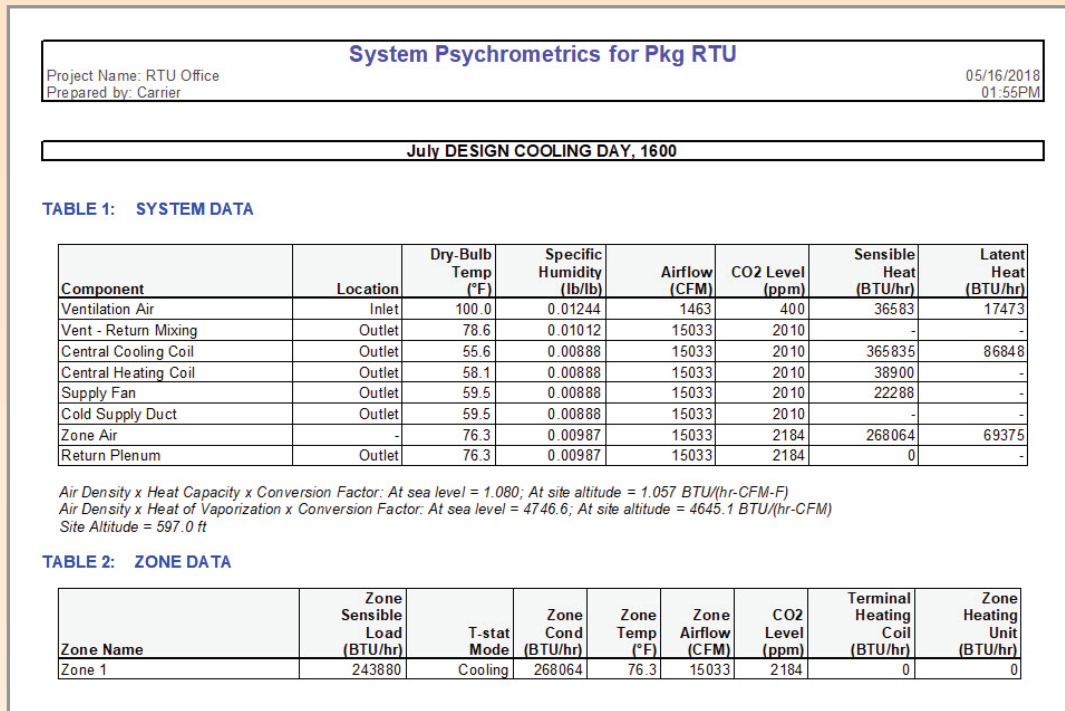


Figure 11. System Psychrometrics Report - Cooling

Graphically, the *System Psychrometrics* report becomes extremely useful (Figure 12).

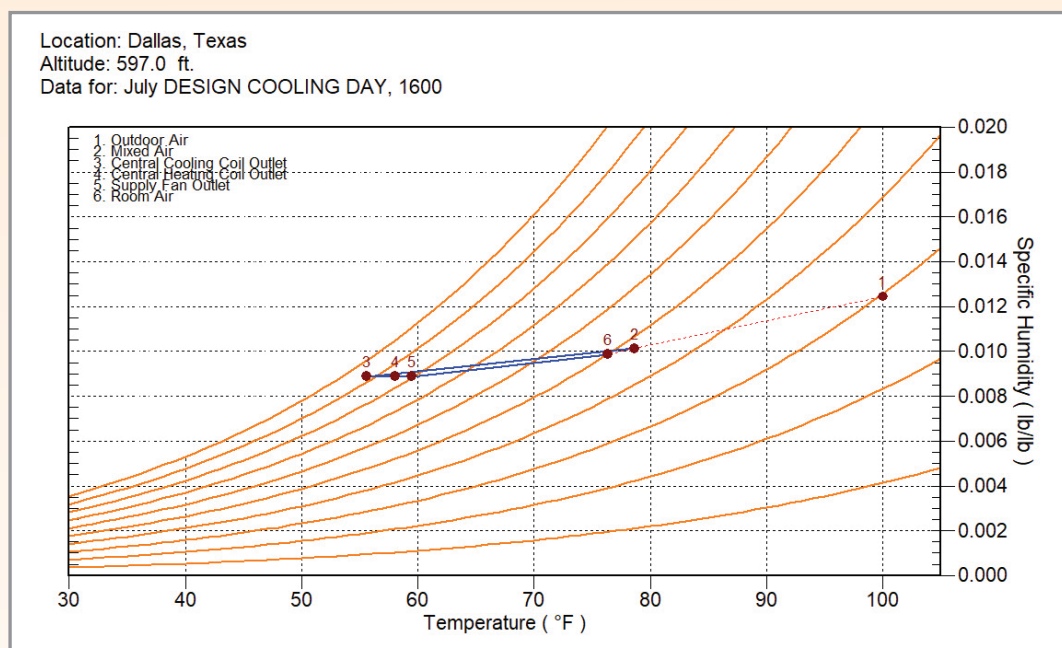


Figure 12. System Psychrometrics Chart - Cooling

(Continued on page 16)

(Continued from page 15)

The psychrometric plot strips away all the tables of numbers and shows all the airside state-points including outdoor air (point 1), mixed-air (point 2), coil outlet (point 3), reheat coil LAT (point 4) supply fan outlet (point 5) and room air (point 6). The cooling coil process (line 2-3) indicates the sensible and latent cooling process the mixed air (outside air + return air) goes through when passing through the cooling coil.

A system that is equipped with a “dehumidification” (reheat) coil will show the reheat process on the psychrometric report as shown here by process line 3-4. A small amount of fan heat is added when the air passes through the fan (line 4-5). The room process (line 5-6) indicates the air condition as it picks-up the room load from the supply air condition to the room or return air condition. The slope of the coil and room process lines

indicates the amount of sensible and latent loads present. The steeper the slope the more latent load that exists and the flatter the line the more sensible, as in the case of the graph shown. It should be noted that this chart (or table) may be plotted at any hour of the year by unchecking the “Peak” box on the report dialog box and specifying the month and hour you desire to see. The same thing applies to the *Hourly Air System* and *Hourly Zone Load* reports, uncheck the “Peak” box to run the reports at any hour of the year.

So, to summarize, you should become intimately familiar with the HAP diagnostics reports to verify system performance. Hopefully this summary discussion has given you some tips and pointers to verify your system design is both reasonable and functioning as intended.



Frequently Asked Questions

FAQ #1: Why is the heat recovery so low on my heat reclaim chiller?

Answer: Low heat recovery can usually be attributed to the building possessing very low heat recovery potential. For a building to have significant heat recovery potential there must be simultaneous requirements for heating and cooling and this must be present a significant amount of the time in significant quantities to allow meaningful heat recovery to occur. This can depend on the physical layout of the building, the way it is zoned, the amount of internal heat gains and losses or even the ambient conditions over the year. In other words, it depends on the building load profile and how frequently simultaneous demands for cooling and heating exist, as well as equipment full-load and part-load efficiencies. There are several possible plant arrangements whereby chillers may be used in heat recovery mode. Some will supply heat to a service hot water (SHW) system instead of or in addition to serving space heating loads. Examples of buildings that may have good heat recovery potential include hotels, dormitories and hospitals. Each of these building types

tend to have large, persistent service hot water (SHW) loads all year long. Therefore, heating demands exist during the cooling season when recoverable heat is available from cooling equipment. In moderate to warm climates cooling demands may exist most of the year, further increasing the number of hours with simultaneous demands. Often the energy use of one system component will increase while others decrease. The net savings is a matter of whether energy efficiency gains offset losses elsewhere in the system.

A previously published *EXchange* newsletter article, [“Modeling Heat Recovery Plants in HAP” \(Vol 4, Issue 1\)](#), contains an excellent article explaining all the heat recovery plant arrangements that may be modeled in HAP. To accompany this article there are also four e-Help articles explaining how to model various heat recovery applications. These e-Helps 031-034 are located on the Carrier eDesign software support web page [here](#):

e-Help Number	Title	Release Date
034	Modeling DHRC in Condenser Loop Heat Recovery	12/05/2014
033	Modeling Heat Exchanger in Condenser Loop Heat Recovery	12/05/2014
032	Modeling A/C Chillers with Heat Recovery Condensers	12/05/2014
031	Modeling DHRC with Cooling-Only Chillers Heat Recovery	12/05/2014

(Continued from page 17)

There is inadequate room here to explore all the possible issues with not being able to recover heat but here are some examples of favorable and unfavorable heat recovery applications.

Hotel, Warm Climate:

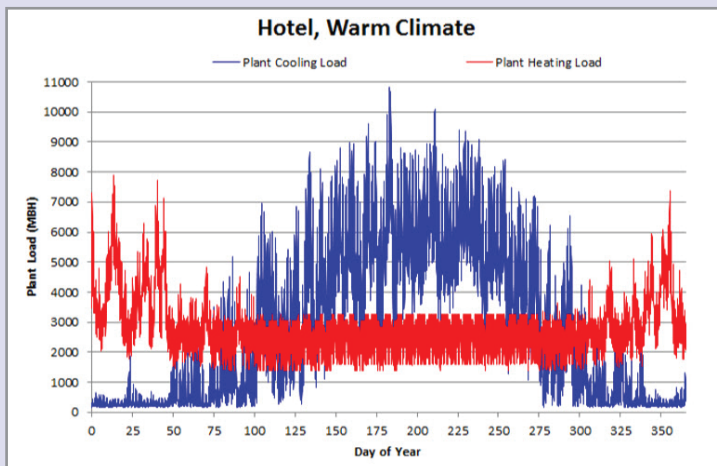


Figure 1. Annual Cooling & Heating Plant Loads – Hotel, Warm Climate

Generate an annual (8760 hr) simulation graph of the cooling and heating plant loads. For heat recovery to occur you should see simultaneous cooling and heating loads, as indicated in Figure 1. As you can see there is a base load between 1500-3200 MBH for service hot water (SHW) all months, as indicated in red. In winter there is an additional building heat load, which is added to the SHW load resulting in spikes up to around 8000 MBH in winter.

Office, Cool Climate:

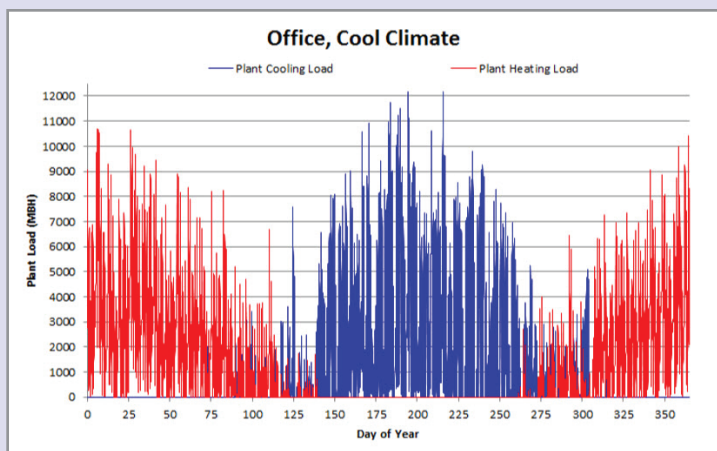


Figure 2. Annual Cooling & Heating Plant Loads – Office, Cool Climate

This is an example of a poor candidate application for heat recovery. The annual simulation plant loads are shown in Figure 2.

Little to no simultaneous cooling and heating occurring. Significant cooling loads exist in summer while significant heating loads exist during winter and a small amount during the shoulder months. SHW loads on an office are usually small as well compared to hotels, hospitals, etc. further decreasing the applicability of heat recovery. So, unless your building has significant hours with simultaneous cooling and heating loads it will not be able to recover much heat.

(Continued from page 18)

FAQ #2: How do I open an old project in the current version of HAP?

Answer: Most HAP users are familiar with how to “convert” an old project archive into a newer or current version of HAP, however in case you do not know how here are the steps:

Converting an old HAP archive to the latest version 5.1

1. Create a new project before retrieving the old project into the current version, otherwise all the existing data in the open project will be overwritten.
2. Choose the “Convert HAP v4.x or v5.x Project” option on the Project Menu. Next specify that you want to convert from an archive file. The program will display a dialog box asking you to identify the specific archive file you wish to retrieve data from.
3. Select the archive file from the list.
4. The selected data will then be read from the archive file and converted to HAP v5.1 format. At the end of the conversion process a message will appear indicating the process is complete. Important information about the data conversion can be displayed by the Help button in this message window. That information includes whether certain data should be inspected because it had to be modified during the conversion. When you return to the HAP main program window, the HAP data you converted will be displayed.
5. Save the project to create a new version of the old project.

But what if the old project is not an archive file but an active project done with an older version of HAP that is saved to your project list? It can still be converted easily. The process is a bit longer and perhaps not as intuitive but is easy to do once you get the hang of it. To convert an old project to a newer version of HAP you follow this process:

Converting an active HAP project to the latest version 5.1

1. Open the latest version of HAP.
2. Select the project whose data is to be converted.
 - a. Choose the Open option on Project Menu.
 - b. In the Open Project dialog change the filter at the bottom of the dialog to show projects of the HAP version you are converting from. For example, if converting from v5.0 to v5.1, choose to show projects from “Hourly Analysis Program v5.0”. Any version HAP v4.0 through v5.0 can be selected. You can also set the drop-down filter to “Show All Projects” if you wish.
 - c. Choose the desired project from the list. If this project has never been opened with HAP v5.1 before, a blank set of files in v5.1 format will be created when you open the project. Thus, when you return to the main window you’ll see a project containing no data yet. Continue with steps 3 thru 6 to fill it with converted data.
3. Start the conversion process by choosing “Convert HAP v4.x or v5.x Data” on the Project Menu.
4. A message will appear warning that v5.1 data in the current project will be overwritten by converted data. This is OK since at this point you have a blank set of v5.1 files in the project. Press “Yes” to continue.
5. On the “Convert HAP v4.x or v5.x Data” dialog, press the “Active Project” button, indicating you want to convert data from an active project.
6. Old version data in the project will then be converted to HAP v5.1 format. At the end of the conversion a message will appear indicating whether the conversion was successful. Important information about the data conversion can be displayed via the Help button in this message window, or via the following Help topic, Chapter 33.2: About Translation of HAP v4.x or v5.x Data.
7. After inspecting the converted data, use the Save option on the Project Menu to save the project data.

2018 eDesign Suite Training Class Schedule







Location	Load Calculation for Commercial Buildings <i>System Design Load HAP v5.1</i>	Energy Simulation for Commercial Buildings <i>HAP v5.1</i>	Energy Modeling for LEED® Energy & Atmosphere Credit 1 <i>HAP v5.1</i>	Advanced Modeling Techniques for HVAC Systems <i>HAP v5.1</i>	Engineering Economic Analysis <i>EEA</i>	Block Load Basic <i>Block Load</i>
Syracuse, NY	July 23, Nov 12	July 24, Nov 13	—	—	—	—
Montreal, QC	Sep 25	Sep 26	—	Sep 27	—	—
Boston, MA	Oct 16	Oct 17	—	Oct 18	—	—
Lafayette, LA	Oct 30	Oct 31	—	—	—	—
New Orleans, LA	11/1 (Course topic TBD. Please check website for details.)					—
Toronto, ON	Dec 4	Dec 5	—	Dec 6	—	—
Denver, CO	Dec 4	Dec 5	—	Dec 6	—	—
New York City, NY	Dec 11	Dec 12	—	Dec 13	—	—

This schedule is current as of May 17, 2018.

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eDesign Suite Software Current Versions (North America)

Program Name	Current Version	Functionality
 Hourly Analysis Program (HAP)	v5.11	Peak load calculation, system design, whole building energy modeling, LEED® analysis
 Building System Optimizer	v1.60	Rapid building energy modeling for schematic design
 Block Load	v4.16	Peak load calculation, system design
 Engineering Economic Analysis	v3.06	Lifecycle cost analysis
 Refrigerant Piping Design	v4.00	Refrigerant line sizing
 System Design Load	v5.11	Peak load calculation, system design



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