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CARRIER SOFTWARE SYSTEMS NEWS

EXchange

Optimizing Ventilation Design in Commercial Buildings Using the Carrier Hourly Analysis Program

Ventilation rate standards have varied over time. More than 110 years ago, there was a general understanding in the industry that proper space ventilation for a building required a minimum of 30 CFM (15 L/s) ventilation air (Janssen 1999). Today, proper space ventilation has been written in a standard codified language for adaptation into the International Mechanical Code and is under continuous maintenance. The Standard, ANSI/ASHRAE 62.1-2010 Ventilation for Acceptable Indoor Air Quality for Commercial Buildings sets the "minimum ventilation rates and specifies the minimum quality of indoor air that is both acceptable to human occupants while minimizing negative effects on their health."

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Specifying the acceptable Indoor Air Quality (IAQ), which is a function of multiple elements, is best addressed by proper design of the heating, ventilating, and air-conditioning (HVAC) system. Sources of contaminants come from outdoors through the outside air intake. Indoor pollutants come from the building occupants and their activities, including building materials and cleaning products to name a few. Since contaminants can be diluted in indoor air by supplying the space with uncontaminated outdoor air (OA), ASHRAE established ventilation rates based on achieving minimum dilution requirements for achieving acceptable IAQ.

Carrier Hourly Analysis Program (HAP) allows users to determine the minimum system ventilation (outdoor air) requirements per ASHRAE Standard 62.1-2010 at the space level, and also, at the system level, which is the OA intake of the HVAC unit.

HAP is a user-friendly computational tool that offers users the ability to very quickly input building and equipment information to compute energy loads and system performance. HAP uses ASHRAE 62.1-2010 equations to determine ventilation requirements for the central system intake to ensure each space receives its required ventilation. This involves finding the critical space, which is defined as the space that exhibits the lowest ventilation efficiency and dictates the overall outdoor airflow for the system.

Optimizing a ventilation system is an iterative process. Making minor changes to the design and reviewing the results of each change can have a substantial impact on ventilation requirements and operating cost. With Carrier's HAP tool, users are able to evaluate numerous iterations quickly and easily.

What’s New in HAP v4.7

HAP v4.7 which will release in early April, focuses on three themes: simulations, systems and standards.

Simulations. With a growing worldwide focus on green and sustainable building, owners and building designers are increasingly turning to heat pump technology to heat and cool medium to large commercial buildings. HAP v4.7 expands its central plant modeling features to support these designs. Three new central plant types are offered:

1. Chilled water/hot water two-pipe changeover plants in which a single set of reversible chiller heat pump equipment produces chilled water to serve cooling loads and hot water to serve heating loads at different times of year. The system changes over from cooling to heating based on a schedule or an outdoor air set-point control. Air-to-water and water-to-water chiller heat pumps can be modeled.

2. Dedicated central hot water plants using air-to-water or water-to-water heat pumps, which can serve space heating loads, service hot water (SHW) loads or a combination of the two loads.

3. Hybrid central hot water plants combining hot water boilers and dedicated heat pumps.

Standard central plant modeling features are offered for all three new plant types. These include single or multiple machines in parallel, sequencing or equal unloading controls, supply water temperature reset controls, constant or variable speed pumps, and primary-only or primary/secondary distribution configurations.

The new plant types can be modeled both for schematic design using the Equipment Wizard feature in HAP, or for comprehensive design using the detailed user interface.

Systems. In buildings such as hospitals, hotels, dormitories, restaurants and schools, energy consumed for SHW can represent a significant fraction of total building energy use. Building designs incorporating energy efficiency measures for SHW systems benefit from detailed modeling to demonstrate the value of these measures. HAP v4.7 provides new features for modeling SHW systems as either a standalone plant serving SHW loads, or in a central hot water plant that serves both space heating and SHW heating loads. Modeling features include hour-by-hour hot water use profiles, equipment performance data and operating controls. Outputs include hour-by-hour estimates of SHW loads and energy use.

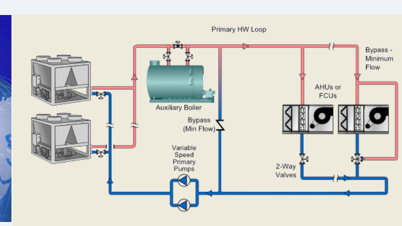
Standards. Finally HAP v4.7 adds features to support code compliance work as local building codes move to adopt ASHRAE Standard 62.1-2010 and ASHRAE Standard 90.1-2010.

Calculating code-compliant outdoor ventilation airflow rates is a key task when designing HVAC systems. HAP v4.7 adds features to default room ventilation rates based on ASHRAE Standard 62.1-2010 requirements and to automatically perform the Standard 62.1 Ventilation Rate Procedure to determine system-wide ventilation airflow requirements.

In addition, features were added to automatically set DX equipment efficiency based on ASHRAE Standard 90.1-2010 minimum efficiency levels. Minimum efficiencies are a function of equipment type, heating type and equipment cooling capacity.

All current licensees of HAP received the v4.7 update automatically and without charge. Prospective customers can obtain a free 90-day demonstration version of the software for evaluation by contacting their local Carrier sales office.

The new features in HAP v4.7 will next be merged into Building System Optimizer v1.20 along with productivity enhancements that include increasing the alternatives per project, the ability to select and arrange alternatives in reports, and a smart calculation feature that minimizes recalculation of alternatives. Release of Building System Optimizer v1.20 is expected by early June.



Frequently Asked Questions

Q. I am conducting an energy study where one of the alternatives is a Ground Source Heat Pump system. How do I model this type of equipment?

A. This system consists of water source heat pump (WSHP) units connected to a closed loop horizontal or vertical ground loop heat exchange piping system. To model this system:

1. Create a new air system. Use Equipment Type = Terminal Units and System Type = Ground Source Heat Pumps (GSHP).

2. Most GSHP systems use a separate ventilation air unit for outdoor air introduction. Specify Common Ventilation System if that applies. See enclosed input screen.

3. In this system each zone represents a separate GSHP unit. Therefore, define a number of zones equal to the number of heat pumps in the system.

4. Enter data for the GSHP system on the General, Vent System Components, Zone Components and Sizing tabs.

5. On the Equipment Tab, press the "Terminal Cooling Units" button to enter cooling mode performance data for the heat pumps.

6. On the Equipment Tab, press the "Terminal Heating Units" button to enter heating mode performance data for the heat pumps.

7. On the Equipment Tab, press the "Miscellaneous Components" to describe the system configuration. Use the Source Water button to configure a heat exchanger whose type is 'Geo, well or surface water.' Note that the program assumes electric auxiliary heaters, if auxiliary heating is needed. No inputs are required to define these auxiliary heaters.

8. Define the average course water (geothermal loop) temperatures each month of the year. During energy

simulations, the program assumes source water at this temperature is available for all equipment-operating hours.

9. Finally, save the system.

Q. I'm running a new HAP project using the ASHRAE 62.1-2007 ventilation sizing method and I noticed in the space usage drop-down there is no category for restrooms. In the old 2001 method there was a space usage called, "PUBLIC: Public Restrooms." Now, I don't see it listed. How do I enter a restroom and how do I account for the exhaust air?

A. Restrooms are no longer on the space usage drop-down list. ASHRAE modified the category list and ventilation requirements when they updated the standard and restrooms do not appear on the 2004 and 2007 tables. Restrooms typically do not need outdoor (ventilation) air. So, any combination of outdoor air, transfer air or recalculated air can be exhausted for these areas. Reference the Standard for exhaust rates. The exhaust rate is set under Air System Properties > Zone Components > Thermostats for the zone that includes the restrooms.

Q. I modeled a system in HAP with two different ventilation control options: Constant and Demand Controlled Ventilation (DCV). I notice on the System Sizing Summary reports the ventilation quantity remains the same for both options. Why is this?

A. This is a common misunderstanding. DCV is a controls (energy savings) strategy not a design (peak load) strategy. A DCV control outdoor air CO2 levels. According to ASHRAE Standard 62 (all versions) there are minimum required ventilation rates for each usage area in the building. These ventilation rates are required minimum values.

Consider the following example: An air handler serves one office space having 1,000 sq. ft. floor area and 10 people. According to ASHRAE Standard 62-2007, the design ventilation rates for an office are:
Rap = 5 CFM/person
Ra = 0.06 CFM/sq. ft.
Where:
Rap = people outdoor air rate
Ra = area (space) outdoor air rate
So for 10 people, the total ventilation required is:
10 people (5 CFM/p) + 0.06CFM/sq. ft. (1,000 sq. ft.) = 50 + 60 = 110 CFM.

This is the design ventilation rate when the space is fully occupied. Of this 110 CFM, 50 CFM is meant to remove occupant-generated contaminants like CO2 and odors, and 60 CFM is meant to remove space-generated contaminants such as out gassing from carpets and furnishings. The 60 CFM component is sometimes called the Base Ventilation Rate. So a DCV strategy allows you to reduce the people component (Rap) of total ventilation in response to varying space CO2 levels. If the space is fully occupied the space requires 110 CFM of ventilation. If half (5) of the people leave, the people component of the ventilation rate might be reduced to have (25 CFM) for a total of 85 CFM (25 + 60).

Regardless of whether you use "DCV" or "Constant" ventilation control, the system must still be sized to deliver 110 CFM of ventilation at the design condition. However, DCV can be used to reduce the people component of the ventilation rate at off-design conditions. If you are performing an energy simulation this is where you will see the benefits of using a DCV control strategy.

2013 Training Class Schedule

Location	Load Calculation for Commercial Buildings	Energy Simulation for Commercial Buildings	Energy Modeling for LEED® Energy & Atmosphere Credit 1	Advanced Modeling Techniques for HVAC Systems
Houston, TX	April 1	April 2	April 3	April 4
Cleveland, OH	April 15	NA	April 16	April 17
Grand Rapids, MI	April 23	NA	April 24	April 25
Pitsburgh, PA	May 6	May 7	May 8	May 9

Additional classes are being added.

eDesign Suite Software Current Versions (North America)

Program Name	Current Version	Functionality
Hourly Analysis Program (HAP)	v4.61	Peak load calculation, system design, whole building energy modeling, LEED® analysis.
Building System Optimizer	v1.10	Whole building energy modeling for schematic design (Available in August 2012).
Block Load	v4.15	Peak load calculation, system design.
Engineering Economic Analysis	v3.01	Lifecycle cost analysis.
Refrigerant Piping Design	v4.00	Refrigerant line sizing.
System Design Load	v4.60	Peak load calculation, system design.

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