Hourly Analysis Program (HAP) Modeling Guide for LG Multi V™

Contents

This Guide

This guide describes how to model LG Multi V™ air source and water source system options with Carrier Hourly Analysis Program (HAP) Building Energy Modeling software. The definitions of the code-words are cited from Modeling Guide HAP 700 Building Energy and Economic Analysis version 4.61. This guide assumes the user is familiar with the operation of the Carrier HAP software. Please refer to the Carrier documentation as necessary during these procedures.

Note: *All material provided herein is for informational or educational purposes only. It is not intended to be a substitute for professional advice. Please consult with your engineer or design professionals for application to your system.*

This Building Energy Modeling Guide is for comparisons and should be used as a guideline only. Building load/energy has been approximated for modeling purposes or input value of equipment (capacity, power input, etc.), and actual results may vary depending on the situation. The conclusions of this Modeling Guide do not guarantee actual energy costs or savings

Note: *This Modeling Guide is a design-and analysis guide to help designers optimize LG Multi V VRF system design based on energy utilization. Modeling accuracy is highly dependent on user-supplied data. It is the user's responsibility to understand how the data entered affects program output, and to understand that any predefined libraries are to be used only as guidelines for entering that data. The calculation results and reports described by this guide are meant to aid the system designer and are not a substitute for design services, judgment, or experience.*

Note: *The Hourly Analysis Program (HAP) Modeling Guide for LG Multi V was developed by LG Electronics, USA, Inc. (LGE). The images and content contained herein are purely for informational and demonstrative purposes. The Hourly Analysis Program (HAP) Modeling Guide for LG Multi V is not endorsed or sponsored by Carrier, Inc. or any of its affiliates or subsidiaries. Please see Carrier, Inc. for additional details regarding use of its software. The Carrier Hourly Analysis Program (HAP) energy modeling software is a product of Carrier, Inc. and all related images and names are owned by Carrier, Inc.*

Multi V™ Air Source Systems

Simulating Multi V Variable Refrigerant Flow Systems

You can use Carrier HAP Building Energy Modeling software to model LG Multi V Variable Refrigerant Flow (VRF) air source systems. HAP provides two methods of creating modeling data, an equipment wizard and a detailed interface.

1. The HAP **equipment wizard interface** takes a "top down" approach. The user answers a relatively small subset of questions about building location, the building itself, HVAC system alternatives, and energy and fuel prices. HAP uses these inputs with default assumptions to generate complete, detailed data for the project.

2. The HAP **detailed interface** uses a "bottom up" approach for creating a model of the building and its HVAC systems. All data is entered by the user. This approach is best suited to detailed design applications where a high level of detail is necessary.

Equipment Wizard

The equipment wizard allows you to quickly define an HVAC design alternative for a building. The wizard consists of 1, 2 or 3 input screens depending on the type of equipment configured. Some wizard input screens offer a Details button to display and modify a second level of more detailed inputs. The systems and equipment wizard screen contains data for air-side equipment. When configuring VRF systems it also contains performance data for the VRF equipment. Figure 1, Figure 2, and Figure 3 are examples of typical wizard screens.
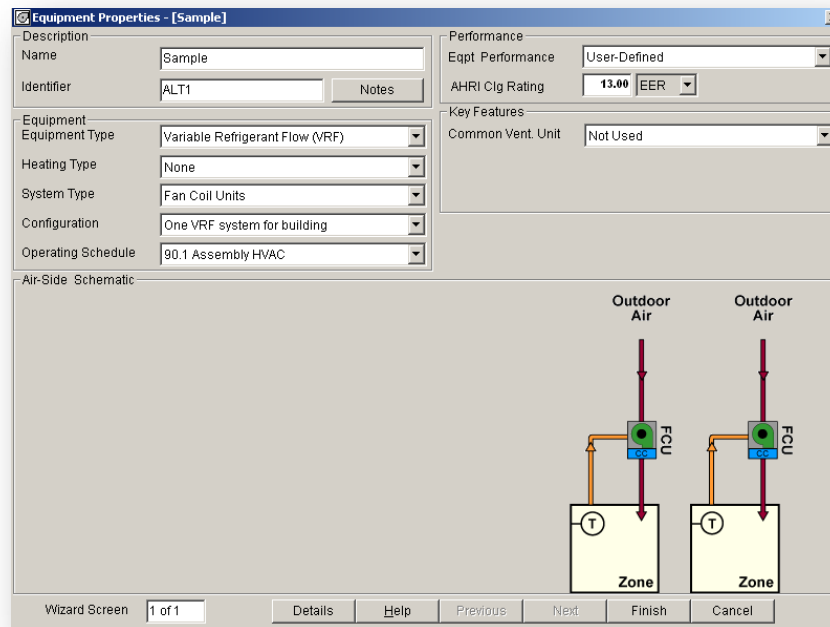
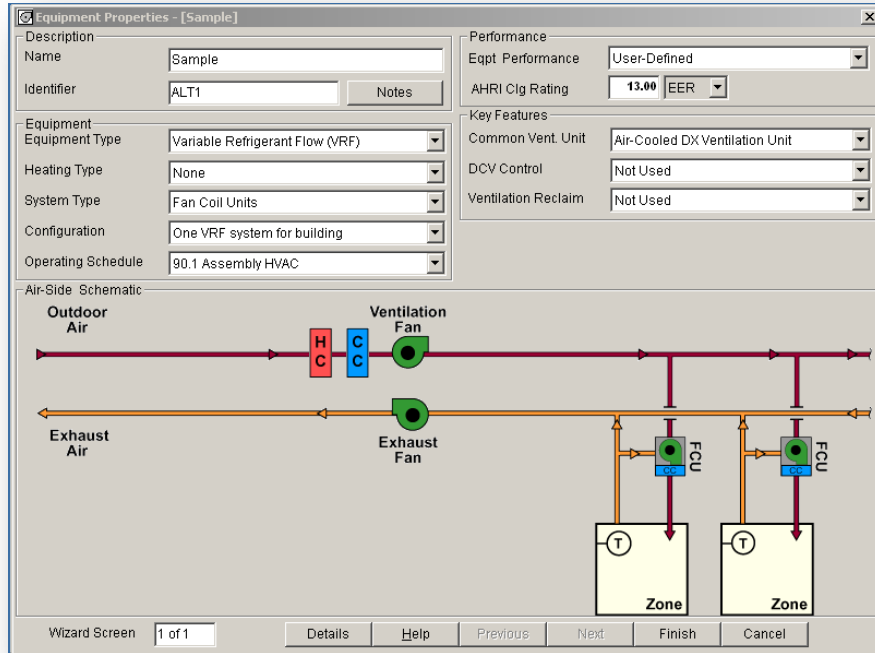

Figure 1 VRF System without Ventilation Unit
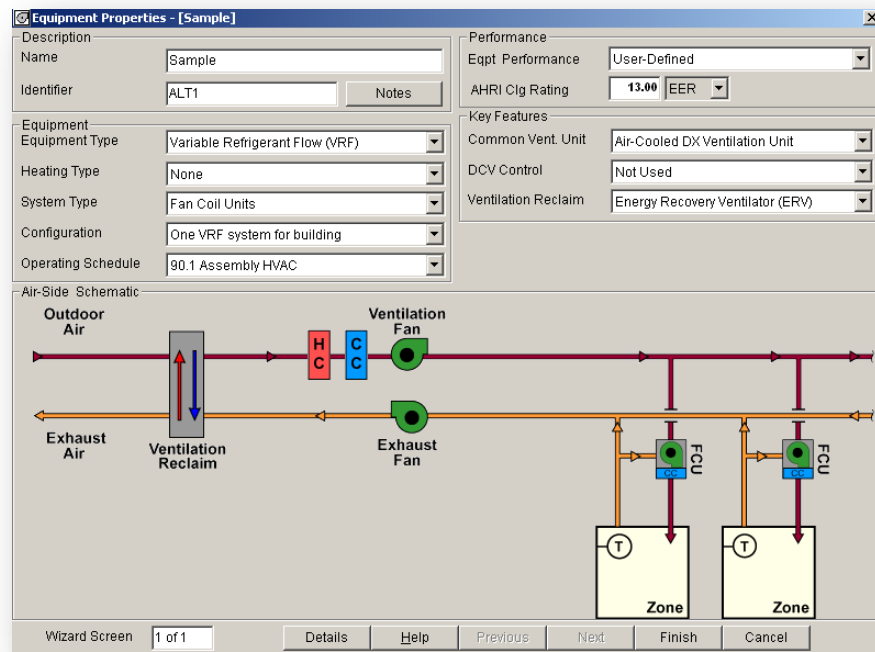
Figure 2 VRF System with DX Ventilation Unit

Figure 3 VRF System with DX Ventilation Unit
and Energy Recovery Ventilator

Equipment Detailed Interface

Air Systems

You can use the detailed HAP interface to define one LG Multi V VRF outdoor unit (ODU) air system for the entire collection of indoor units (DX fan coil units). Loads and energy use are added to get system totals, which are displayed on the simulation reports.

Follow these steps for the detailed interface. Refer to Carrier HAP documentation as necessary.

Note: *On the HAP display screens, VRF indoor units are referred to as fan coil units or terminal units.*

---

1. Specify the Equipment Class as "Terminal Units."
2. Specify the System Type as "Variable Refrigerant Flow" and enter system data.
3. Define performance characteristics of the DX cooling equipment using the Equipment Tab on the Air System window.
4. If heat pump heating is used, define performance characteristics of the equipment using the Equipment Tab in the Air System window.

Plants

If an air-source heat pump is used then no plant equipment selection is required. If the heating plant serves multiple air systems, define and link it to all air systems containing.

Building

If heat pump heating is used, link the air system directly to the building.

Equipment Data for VRF Outdoor Unit

This window (Figure 4) contains equipment performance data for the VRF outdoor unit.

Equipment Sizing

For energy analysis during the preliminary design phase of a project, it is often appropriate and quicker to choose the "Auto-Sized Capacity" option. For detailed energy analysis modeling of a specific unit, choose "User-Defined Capacity" to enter the unit's cooling and heating capacities.

Design OADB

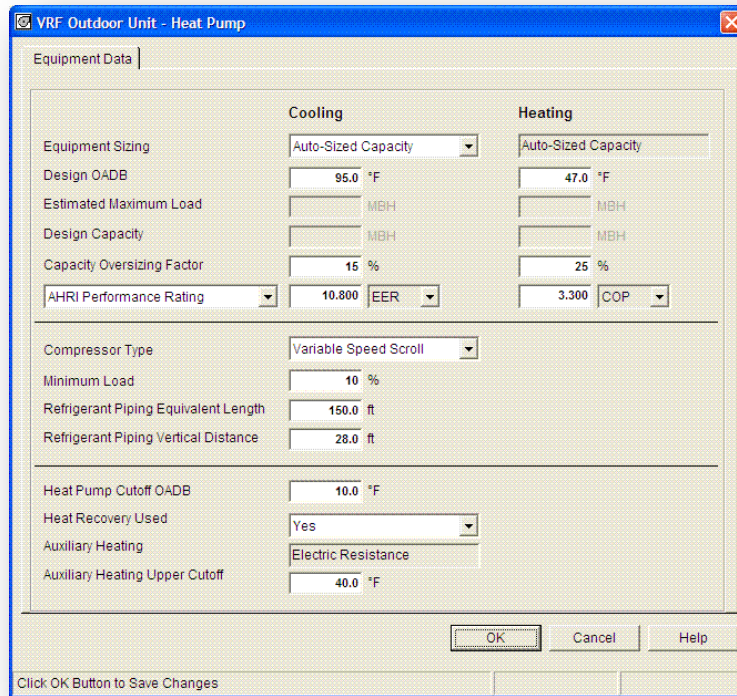Enter outdoor air temperature for peak load time.

Figure 4 VRF System with DX Ventilation Unit

Estimated Maximum Load

HAP generates the estimated maximum load during system design calculations. The load provides guidance when specifying gross capacity. If system design calculations have not been run, this field is blank because the data does not yet exist.

Design Capacity

This field is enabled only if you selected "User-Defined Capacity" for Equipment Sizing. Enter the gross cooling capacity of the VRF outdoor unit at the cooling design OADB and the gross heating capacity at the heating design OADB. These values, together with design OAT and input power, serve as the anchor point for off-design and part-load performance calculations.

Capacity Oversizing Factor

The oversizing factor is additional capacity added when using the "Auto-Size Capacity" option. For example, if the estimated maximum load for an ODU is 100 MBH and the oversizing factor is 15%, Auto-Size sets the gross cooling capacity to 100 x (1.15) = 115 MBH.

Performance Value

This value is the energy performance of the ODU. Specify separate values for cooling and heating duty. Two options are provided for defining this data:

- AHRI Ratings

    The AHRI rating is determined at the standard rating OAT of 95°F for cooling and 47°F for heating. It includes compressor, indoor fan and outdoor fan power. HAP uses the rating to calculate compressor and outdoor fan kW, subtracts the indoor fan

power, and adjusts for any difference between the AHRI rating condition and the design OAT you specified for this equipment.

- Compressor and Outdoor Fan kW

  HAP uses the input kW with the design OAT and gross capacity as the anchor point for off-design and part-load performance calculations.

Compressor Type

Choose variable speed scroll.

Minimum Load

Enter the minimum load value. Below minimum load the equipment cycles on and off to meet the load. Above minimum load the equipment stages compressors and adjusts compressor speed to meet the load.

Refrigerant Piping

- Equivalent Length

  Equivalent length is the length (in feet) of the refrigerant piping from the outdoor unit to the most distant indoor unit, plus an added length to account for elbows, y-branches, and heat recovery boxes or other components. The equivalent length must consider both horizontal and vertical sections of piping.

- Elevation

  Elevation is the vertical distance from the bottom of the outdoor unit to the indoor unit that is the greatest vertical distance from the outdoor unit. The greater the vertical distance between outdoor unit and indoor units, the larger the cooling or heating output required to meet demand at the indoor units.

  o Enter a positive value if the outdoor unit is above the indoor unit (for example, a roof-mounted outdoor unit).
  o Enter a negative value if the outdoor unit is below the indoor unit (for example, a ground-level outdoor unit serving indoor units on upper floors).

Heat Pump Cutoff OADB

When OADB drops to this value, the heat pump turns off and the equipment runs with 100% auxiliary heat.

Heat Recovery Used

Specifies whether the system has heat recovery capability. With heat recovery, hot gas returning from indoor units in cooling can be used to satisfy part of the demand of other indoor units in heating, or cold liquid refrigerant returning from indoor units in heating can be used to satisfy part of the demand of other indoor units in cooling.

Auxiliary Heating Upper Cutoff

When OADB rises to this specified value, auxiliary heating is locked out. For example, if the cutoff is 40 F and auxiliary heating is required when the OADB is 45 F, auxiliary heating will not turn on.

Modeling Indoor Units

Single-zone indoor units provide a constant volume of conditioned air. Ventilation air may be provided to the indoor unit directly from ambient as shown in Figure 5.
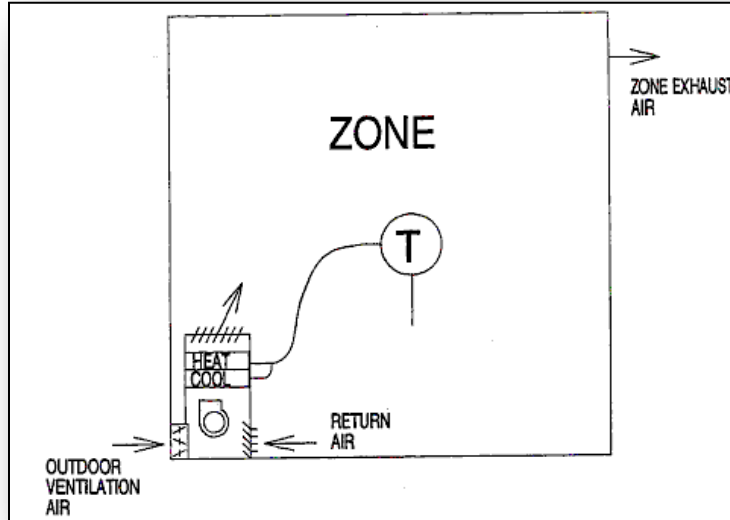

Figure 5 Terminal Unit Schematic (Direct Ventilation Example)

Alternatively, tempered or untempered ventilation air can be provided by a centrally located ventilation unit (for example, DOAS). When centrally located ventilation is used, HAP assumes ventilation air is ducted to the inlet of each indoor unit. This arrangement is shown in Figure 6.
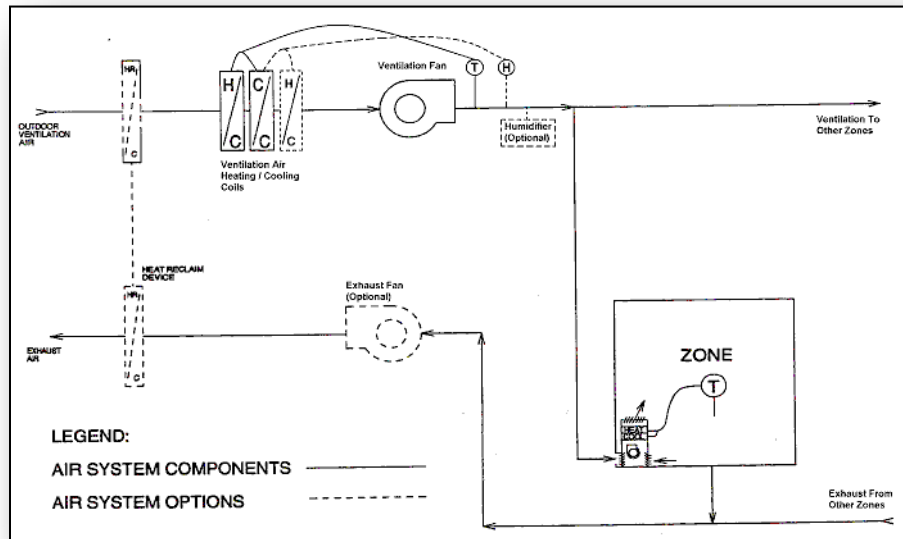

Figure 6 Terminal Unit Schematic (Common Ventilation Unit Example)
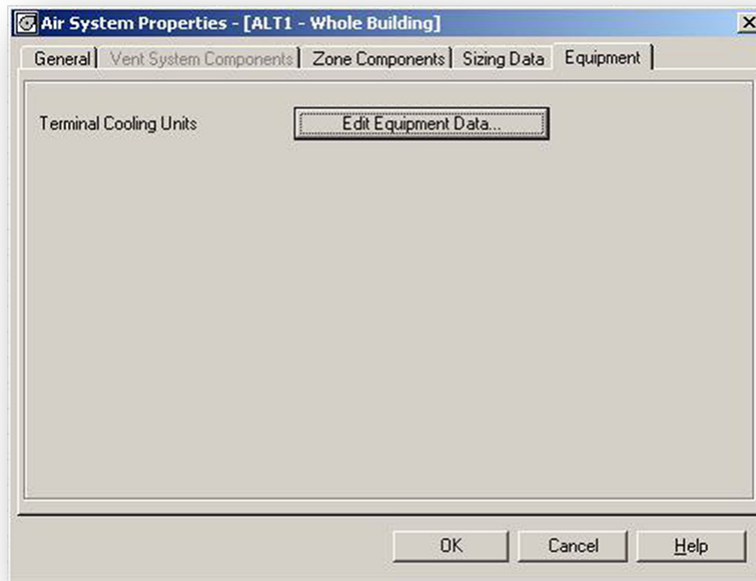
Equipment Tab / System Form

Figure 7 Equipment Tab (Typical)

The Equipment Tab (Figure 7) displays a list of items with an edit button for each. The number of items in the list depends on the equipment and the cooling/heating sources you specified earlier. To enter or edit equipment data, press the Edit button of the desired item. A window displays containing data for this item (Figure 8).
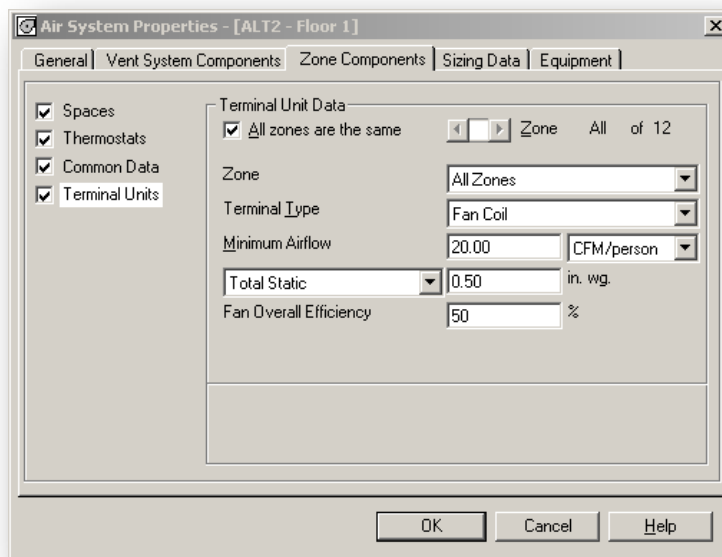

Figure 8 Terminal Units Data

Multi V Water Source Systems

You can also use Carrier HAP Building Energy Modeling software to model LG Multi V water source systems (Figure 9). HAP provides the same two methods of creating input data as for air source systems. For details, refer to the air source description in this guide.

A water source heat pump (WSHP) loop serves water-loop heat-pump systems. Individual WSHP units operate according to their zone thermostats, and reject heat to or take heat from this loop. Depending on the relative number of units operating in heating or cooling mode, the loop will be thermally unbalanced and loop temperature will either rise or fall. One or more boilers and one or more cooling towers keep the loop within specified limits. In addition to WHSP units, any cooling unit with a water cooled condenser may be assigned to this loop.
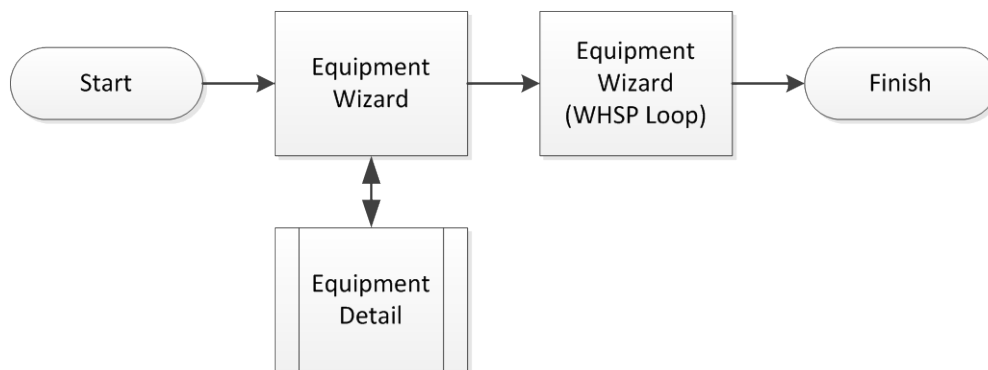

Figure 9 Water Source Heat Pump Modeling Procedure

References

1. HAP QUICK REFERENCE GUIDE CARRIER CORPORATION. 2012
2. 2012 ASHRAE Handbook–HVAC Systems and Equipment, Chapter 18 Variable Refrigerant Flow
3. ASHRAE/IESNA Standard 90.1-2007 : http://www.ashrae.org