

# VRF Zoning: An Ideal HVAC Solution for Multifamily Applications



White Paper

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Variable Refrigerant Flow (VRF) zoning systems are the fastest growing segment of the U.S. HVAC market. This paper describes the major benefits of VRF zoning systems and how they meet the demands of designing and building multifamily housing. In addition, you'll learn how VRF zoning systems can help multifamily buildings earn points toward LEED®, Green Globes and ENERGY STAR® certifications. Three case studies provide examples of how others have solved some of the HVAC-related challenges of multifamily housing.

## VRF Zoning System Features

VRF zoning is a method of providing precise comfort control to buildings with multiple floors and areas by moving refrigerant through piping to the zone to be cooled or heated. VRF zoning systems can simultaneously cool some zones while heating others. Regardless of time of day, sun or shade, season of the year or special requirements, VRF zoning systems provide personalized comfort to each zone or space. Features include:



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**Design and installation flexibility.** Installation is possible in tight spaces because the two-pipe design and compact components of VRF zoning systems require less space than conventional systems.

**Lighter weight.** VRF zoning systems are 31 percent lighter than chilled-water systems. The result is easier and lower transportation costs. The necessary structural support is less than that of conventional equipment because of the lighter equipment weight and the modular design that allows the load to be distributed across an existing structure.

**Discreet indoor units.** A wide variety of indoor unit styles offer design flexibility. Ductless options include wall-mounted, floor-standing (exposed and concealed), ceiling-recessed cassette and ceiling-suspended. Ducted options include vertical-concealed and ceiling-concealed.

**Energy efficiency.** VRF zoning systems consistently perform at 25 percent higher efficiency than conventional systems. The outdoor units feature an INVERTER-driven compressor that varies the motor rotation speed, allowing it to precisely meet each zone's load requirement while reducing power consumption. Supporting load diversity, the system's total capacity can be distributed to each indoor unit via the branch circuit controller.

**Lower life-cycle costs.** Energy savings as well as reductions in total installation and maintenance costs result in a lower life-cycle cost for VRF zoning systems when compared to conventional systems.

**Quiet operation.** Conventional systems often start up and shut down with a bang and run with noisy rushes of air or water flow. The indoor and outdoor units of VRF zoning systems operate at very low decibels providing a quiet indoor environment.

**Control Options.** Several controller types are available for individual temperature control. The central controller can monitor, schedule and control up to 50 indoor units through a web browser interface. Multiple central controllers can be networked together with an integrated centralized control software and systems can be tied to a BMS using LonWorks and BACnet protocols.

## Benefits of VRF Zoning Systems for Multifamily Applications

Multifamily applications have many cooling and heating requirements that an HVAC system must meet. Requirements include the need for peak load flexibility, individual comfort control, energy efficiency and ease of installation and maintenance. Installing a quality cooling and heating system, such as a VRF zoning system, addresses many of these challenges. VRF zoning systems provide lower utility costs and higher occupant comfort levels, which may result in higher occupancy rates, reduced turnover, an edge over the competition, and in some cases, higher than average rent.



**Aljoia Mercer Island, Senior Living Community**  
Mercer Island, Washington

**Peak Load Flexibility.** In multifamily buildings, the uncertainty of occupancy times makes it difficult to estimate peak demand or energy use. Also, it is difficult to predict how much energy the occupants will use in any given unit. VRF zoning systems' variable speed compressors accommodate a variety of partial and full load conditions, making them ideal for multifamily applications where energy use schedules are unpredictable.

**Space Saving.** VRF zoning systems require little or no ductwork depending on the selected indoor units, which maximizes square footage.

The reduced ductwork allows the systems to be installed in buildings without existing duct systems, or reclaim spaces formerly devoted to larger mechanical systems. The small footprint of outdoor units allows for the elimination of mechanical rooms, freeing up additional interior rental space. On the exterior, the outdoor units are much smaller than conventional boiler/chiller systems. As a result, less rooftop or ground property space is needed for the condensing units. Building owners and developers can use extra rooftop and other outdoor space for community use, adding to rental or amenity values.

**Retrofit Capabilities.** Greater than half of the multifamily units in the United States are more than 30 years old with similarly aged HVAC systems<sup>1</sup>. VRF zoning systems are ideal for retrofit applications. The flexible and low-impact modular design enables the installation of a modern HVAC system while preserving the architectural integrity of the space.

**Maintenance.** VRF zoning systems offer easy maintenance. One unit can be serviced without taking the whole system offline so there is minimal tenant disruption. Indoor units feature washable filters that are easy to clean or replace. Built-in diagnostics through the system controls and Maintenance Tool™ aid in troubleshooting.

**Individual Comfort Control.** VRF zoning systems provide each tenant unit and public space with its own comfort control system. The system increases occupant comfort and decreases maintenance complaints. Centralized software gives building management control over hallways and unoccupied units. Building management can also monitor and control the systems remotely through a smartphone or other Internet-enabled devices.

<sup>1</sup> Environmental Protection Agency, "Enhancing the Value of Multifamily Housing Projects with ENERGY STAR Qualified Products," [www.epa.gov](http://www.epa.gov)



## Green Certification Programs

VRF zoning systems can help multifamily buildings achieve certification from LEED, Green Globes and ENERGY STAR programs. The systems are energy-efficient and provide a way to measure and verify energy usage through the controls network — necessary for certification by any of these programs.



**LEED.** The U. S. Green Building Council (USGBC) increased its requirements for energy efficiency and outdoor air delivery in the latest LEED (Leadership in Energy and Environmental Design) rating system. The updated version, LEEDv4, adopted ASHRAE Standard 90.1-2010. This standard calls for a 30 percent energy improvement over the 2004 standard. VRF zoning systems are up to 25 percent more efficient than other types of HVAC systems and can help buildings meet or exceed this goal. VRF zoning systems contribute a sizable number of points in the Energy & Atmosphere (EA) and Indoor Environmental Quality (IEQ) categories. The INVERTER-driven compressor technology reduces energy consumption. The control system measures performance and

operates quietly. The use of the VRF outside air systems coupled with demand-control ventilation can provide additional energy savings that contribute to the overall efficiency of the system.



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**Green Globes.** The same VRF zoning features that contribute to earning LEED points help meet Green Globes requirements. This alternative to LEED is a web-based program of the Green Building Initiative, Portland, Ore., and has eligibility requirements but no prerequisites. Assessment areas include energy efficiency, indoor environment, emissions and environmental management.



**ENERGY STAR®.** A building is eligible for ENERGY STAR certification if it performs better than 75 percent of similar buildings nationwide. The score accounts for differences in operating conditions, regional weather and other factors. Information in the certification application must be verified by a licensed Professional Engineer or Registered Architect.



## CASE STUDY: Union Mill

An adaptive reuse project turned a historic 86,000-square-foot Union Mill in Baltimore into a vibrant mixed-use complex. The complex consists of 56 one- and two-bedroom apartments set aside for teachers new to Baltimore. The remaining space includes 30,000 square feet of office space for Baltimore's education, health and human service nonprofit organizations and a 1,500-square-foot restaurant.

**Challenge.** The design team had to solve a number of problems when specifying the HVAC system. They had to take into consideration sightlines for the placement of mechanical equipment on and around the 146-year-old structure and the City of Baltimore's zoning and noise restrictions. The building had a pitched roof that would not support boilers, chillers or outdoor condenser units and thick stone walls that made installing ductwork impossible. A conventional split heat pump system would call for up to 160 individual split-system units that would be impossible to hide. Placing 160 outdoor units in the courtyard or behind the building was not an option, so a conventional split system with heat pumps was out of the question.

**Solution.** Consultants Allen & Shariff Engineering and distributor Aireco Supply suggested a VRF zoning system from Mitsubishi Electric US Cooling & Heating Division (Mitsubishi Electric). They determined that no other type of HVAC system could meet the unique needs of Union Mill.



**Union Mill**  
Baltimore, Maryland



**Union Mill**  
Baltimore, Maryland

**Result.** With the help of the VRF zoning system, Union Mill was the first project certified under the Baltimore City Green Building Standard. The project earned developers, Seawall Development Company (Seawall), a cash rebate of \$164,258 from Baltimore Gas & Electric's Smart Energy Savers Program.

"This is a fantastic system," Seawall partner Evan Morville said. "Everything in the building is electric, and thanks to the ingenious engineering of the Mitsubishi Electric variable speed compressors and heat exchangers, my average apartment energy usage is only \$50 a month."



## CASE STUDY: Doan Apartments

Turning a Victorian-era school with two 1950s additions into a multifamily facility was the challenge facing Cleveland-based not-for-profit affordable housing developer, Famicos Foundation (Famicos) and City Architecture. The goal was to create 45 apartments for senior citizens in Cleveland's Doan School, which is listed on the National Register of Historic Places.

**Challenge.** The old wooden roof had allowed water to seep into all levels of the building, which had to be gutted. Ancient boilers and through-the-wall air conditioning units had to be removed. The project required a completely new HVAC system.

**Solution.** “For this historically demanding installation, the Mitsubishi Electric VRF zoning engineering solved a host of problems,” said mechanical engineer Joe Denk, of Denk Associates. “In addition to the great design flexibility of the VRF zoning system’s piping and wiring, the size of the units, both the outdoor compressors and indoor fan coils, played a major role in turning former school space into real residential apartments. I don’t know of another system which could make these accommodations.”

Because of the building’s huge windows, spacious halls, skylights and 10-foot ceilings, Denk worried that the vertical air handlers that had been installed in closets might not provide adequate heat. His concerns were dispelled, however, as soon as the system fired up. “The Mitsubishi Electric engineering moves air with great authority,” he said. “The VRF zoning equipment is extremely quiet and has superior fans, controls and conditioning capability.”



**Doan Apartments  
Cleveland, Ohio**



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**Result.** The system helped Famicos earn Enterprise Green Communities certification. The Doan Apartments also received an \$8,000 rebate from Cleveland Public Power’s Efficiency Smart program, and every apartment achieved a HERS (Home Energy Rating System) rating from 85 to 100 – equivalent to that of new construction.

## Conclusion

VRF zoning systems provide a high-quality cooling and heating solution that meets the unique demands of multifamily construction. VRF zoning systems provide individual comfort control, energy efficiency, small footprint, installation flexibility and easy maintenance. These features result in occupant benefits including increased occupant comfort and lower utility bills. Multifamily developers also benefit from VRF zoning's ability to help achieve green building certifications, less maintenance cost and increased rental space.



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