

MINI-SPLIT/ERV OPTION LOWERS CAPACITY AND ENERGY CONSUMPTION

Combining ductless mini-splits with an ERV and some HVAC experience and ingenuity brings comfort to interior spaces.

BY DAN VASTYAN

Images courtesy of Fujitsu and Modine.

Every once in a while two separate technologies come together so fluently that they dramatically improve the other's performance and application possibilities. Such is the case with a commercial rooftop energy recovery ventilator, and a ductless mini-split heat-pump system. The real benefactors of the union are the 350 members at the Cornerstone Presbyterian Church in the town of California, MD.

The design phase for a new wing of the church was a six-month process. Several contractors, reps and engineers brought different views about how to condition the single story, 14,000-sq-ft addition mainly comprised of classroom space.

One option that was proposed included more than 30 single ductless systems (one outdoor unit per indoor unit), which were planned to be set on the ground outside. Then, in order to supply conditioned make-up air in the cooling mode, the plan called for two 10-ton A/C units and 80-kW heat strips in the air handler for winter make-up air.

After careful consideration, church members decided against the original design and settled on a unique hybrid system that would tap an ERV to supply make-up air to mini-splits equipped with make-up air collars. The system eliminates the 10-ton units and decreases the electric heat capacity by 60 kW. In addition, the selected system allowed them to connect eight indoor units to each outdoor unit, drastically cutting the number of outdoor units. This system beat the other proposed system from three angles—amount of equipment needed, ease of installation and overall energy efficiency.

Looks good on paper

Initially, using an ERV to supply outside air to ductless mini-splits was Frank Simmons' brainchild. Simmons, Owner of Simmons Heating and AC in Hollywood, MD, knew he would need to pull some expertise on board to design and refine the system. He also knew the hybrid system he was hoping to install was—for the most part—uncharted territory.

He took his idea to Ken Herne at the manufacturer's rep firm Harry Eklof & Associates Inc. located in Landover,



⚡ Mechanic Mike Blaylock prepares a flare fitting for connection to a ceiling cassette unit.

MD—a company that has 10 years of experience with ductless heat-pump applications. Pat Cosgrove, of Northeastern Supply in Leonardtown, MD, was also involved with the design. Together, the group found a way for the church to dramatically lower installation and operating costs while providing equal or greater occupant comfort and indoor air quality.



^ Jose Cortes and Scott McGuire install filters on the Modine equipment's ERV, which preconditions make-up air for air collars installed on heat-pump ceiling cassette units.

“Frank and I designed the system together,” said Herne. “Pat and I have worked with him on other challenging projects, so I knew he could handle this one.”

They proposed using “hybrid flex inverter” ductless heat pumps with ceiling cassette evaporators equipped with outside air collars. Typical ductless systems simply use linesets to move refrigerant from the condensing unit outside, to the evaporator inside. These specific ceiling cassettes do that, but they also use an air “collar” for optional make-up (ventilation) air. These units not only heat and cool the room by circulating existing air, but they also bring air in via a 4-in. duct that runs to the collars.

The quandary came when it was time to select the ERV. At the beginning of the design phase, there were not any obvious best options. No single ERV manufacturer had exactly what they were looking for, which was a packaged system that combined a robust ERV capability with electric heating and cooling capacity. Then a new packaged rooftop unit hit the market.

The unit they selected to work in tandem with the mini-splits was a 15-ton packaged ventilation unit that offered ERV, A/C and heating-system capabilities in a compact rooftop package. At Cornerstone, the unit supplies ERV-conditioned air to the collars on the cassette units, reducing the required capacity of the heat pumps. The unit's ERV is rated

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at 65% “effectiveness” (a term used by the Heating Ventilation Institute to describe how effectively an ERV transfers energy from the exhaust air to the supply air).



» Scott McGuire connects refrigerant lines to a Fujitsu ceiling cassette unit.

“Should the heating or cooling capacity of the heat pumps be exceeded, we capitalize on the modulating ability of the ERV’s heating and cooling elements, delivering only the capacity needed to meet the demand, and no more,” added Herne.

Equipped with 20-kW backup heat and CO₂ sensors, the unit will also run whenever the building’s air needs exchanged.

Ahead of the game

According to Wayne Davis, owner of W.M. Davis (the general contractor), hiring local subcontractors who are more accessible for warranty work and stand behind their products and services was a success as well.

“I brought Simmons on as council during the design phase,” said Davis. “He knows his equipment, and his projects always deliver good value, sensible design and reliability.”

“I think, as a professional in this industry, it’s my job to keep pace with rapidly changing technologies and installation techniques,” noted Simmons. “There’s a learning curve that comes with being an early adopter of any new technology, but there’s no reason to be installing equipment that’s obsolete.”

The original design submitted by another subcontractor included a 4,000-lb ERV unit the size of a utility van, in addition to the two 10-ton A/C units, all installed in the church’s attic. The approach also included extensive ductwork. It also suggested the use of more than 30 ductless units; two per classroom, with compressors scattered in landscaped beds and public-access areas.

More ductless units throughout the building meant a more intrusive installation process and longer install times. Compressors placed all around the exterior of the building are an eyesore, and are susceptible to vandalism and accidental

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damage (balls, mowers, etc.). Also, overgrown shrubbery, lawn clippings and mulch/dirt splash from rain reduce the efficiency of the unit if not maintained regularly.

Herne and Simmons’ design allowed for each of the eight compressors to be mounted on the roof. A roof-mounted system meant shorter (and easier to install) lineset runs, whereas a ground-mounted unit would have required the lineset to go up an exterior wall (again exposed to elements) or penetrate the wall and go up the inside of the wall. It must then run across either the roof or interior of the ceiling and down to the evaporator in the conditioned room. Linesets on a roof-mounted system are often shorter, as the condensing unit can be placed very close, if not directly over the respective evaporator.

Regulatory advantage

The need to meet ASHRAE Standard 62.1 fresh-air requirements was a critical design factor. Carbon-dioxide levels needed to be kept in check, so occupant capacity and interior square footage were calculated to determine the proper number of air changes per hour (ACH).

Another ASHRAE-approved method to reduce CO₂ was a sensor-based IAQ method. With sensors inside the building, the ERV provides tempered exchange air whenever measured CO₂ reaches a maximum set level. Only then will the ERV increase fresh air flow.

“Using sensors instead of the prescribed calculation method to determine required ACH reduces the amount of air we need to move by 60% or more,” said Herne. “That alone substantially shrinks energy costs to circulate, heat and cool the air.”

“We were glad to hear that mingling the heat-pump units with the ERV meant less total installed capacity,” said Scott Hoffman, head of the church’s building committee. “But the ductless units are also great because of their ability to condition the church on a room-to-room basis. That way we aren’t heating or cooling any rooms that aren’t in use.”



⤴ **Frank Simmons, Owner of Simmons Heating and AC, in Hollywood, MD, looks over a unit before installation at the Cornerstone Church.**

Hit the ground running

In September of 2011, ground was broken for Cornerstone Church’s long-anticipated addition. The new portion of the church includes 18 classrooms, a kitchen and a gymnasium. Each classroom can be divided in half by a floor-to-ceiling partition. Two thermostats and two cassette units allow the separate portions of the room to be conditioned individually if the partition is drawn.

The dual-cassette approach also permits redundancy, and allows for system modulation down to less than 10% of their combined capacity to further reduce energy consumption.



⤴ **Jose Cortes, Technician’s Helper, getting ready to put together a distribution box at a Cornerstone church.**

One air handler is always available to maintain temperature so that all spaces may remain in use if a cassette fails. The indoor units at Cornerstone Church are connected to eight 48,000-Btu flex-inverter heat pumps.

The gymnasium is the only portion of the project that does not use the ductless/ERV system. Two 20-ton rooftop units use Simmons’ custom-made ductwork to deliver conditioned air to the gym.

According to Herne and Simmons, the only challenge was working around the overhead clearance for the air collars on the evaporators, which need an extra 4 in. when compared to a unit without a collar. Although there is not a second story, there is a sheetrock firewall above the drop ceiling that limits the space above.

“The framers just left a little cavity to allow us to install the cassettes,” said Simmons. The grid-work that suspends the drop ceiling was squared off of the cassette in center of each room.

The Cornerstone Church project not only showcases how a mid-sized HVAC firm can handle intricate jobs, but also how a solid dealer/rep relationship is a key to success for everyone involved. ☁

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