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Single Pipe Hydronic System is “Green”

By Greg Cunniff, PE, Applications Engineer Manager, Taco, Inc. As appearing in Plumbing Engineer

As the quest for greater energy efficiency in HVAC systems is given new impetus by the rise of the “green buildings” movement, hydronics is getting a new look by system designers who seek to design commercial buildings to a new environmentally conscious standard. That’s because hydronics provides a “green” solution in meeting two important environmental goals – less materials used for the HVAC system itself and less energy consumption through its operation. A recent development in hydronic system design – the single pipe system – meets both these goals while providing superior comfort over other systems, like air.

A single pipe hydronic system has been around for a long time actually, but it was limited to residential applications. This system was easy to design and install, and it was competitive because it used less materials and was mostly self-balancing. But it couldn’t provide individual zone control so it couldn’t be extended into the commercial realm. Now a single pipe system exists that is primarily designed for commercial use.

This system, which has a single pipe primary main, utilizes terminal units configured with decoupled secondary circuits. It also utilizes one of hydronics’ most standard items of equipment – wet rotor circulators to provide differential pressure to direct water through the secondary system. In a single pipe system the circulators direct water to where it needs to go, as opposed to forcing the water through a conventional two pipe system’s longer piping loop.

Simplicity is the hallmark of the single pipe system. A conventional two pipe system requires a supply and return pipe in the primary circuit, which naturally takes up more space. That can prove challenging, depending on the application, if space is at a premium. A single pipe system, however, has only one pipe to be installed and that delivers both space and labor savings. For the installer the single pipe system is a real bonus: he’s only installing one pipe and usually the same size pipe throughout, with no need for reducers, increasers, etc.

The primary system consists of a single constant pipe size circulating all the flow for the entire system throughout a building. Each terminal unit has its own decoupled secondary piping circuit with a dedicated circulator for that zone. Because the circulator can be controlled based on temperature in the zone, on/off or by a variable speed drive, very accurate temperature control in each zone can be achieved, providing greater comfort.

With the use of circulators, control valves aren’t necessary. And because the flow in all secondary circuits is independent of the flow in the primary circuit, the need for balancing valves at the terminal unit is also eliminated. By eliminating both types of valves, and having only a single pipe primary circuit, the system is both simple in its design and uses far less materials – some 40% less pipe and fittings, no control valves and almost no balancing valves.

It is also energy efficient because, as a hydronic system, it requires less horsepower to move BTU’s around a building than an air system because water is denser than air and has a higher specific heat. Also, a single pipe system has a lower head loss than a conventional two pipe system due to the elimination of the control valve and balancing valve pressure drops. As a direct result, energy consumption to operate the circulators in a single pipe system is less than the fans in an air system or the circulators in a two pipe system. These savings, plus reduced maintenance of the circulators, can add up to big savings – up to 30% of life cycle costs.

Engineers are becoming true believers of the single pipe hydronic system once they see how easy it

is to design, how quickly and efficiently it can be installed and maintained, and how it saves energy and materials. Questions about temperature cascade and the value of substituting pumps for valves have been answered to their satisfaction. Engineering design firms across the United States and Canada, once they have been introduced to the single pipe system, are opting to use it in multiple projects, and especially in those with a LEED certification design objective. As one design engineer, Chris Schreel of Applied Mechanical Systems, of Dayton, Ohio, has stated: "The single pipe system is a simple, streamlined system that's highly functional."

As examples of installed single pipe systems, let's look at three completed design projects and see how the engineering firms and mechanical contractors involved were won over by the simplicity, savings and comfort of the single pipe system.



A Masonic temple becomes a luxury hotel

The Hotel Monaco, a luxurious, boutique-style hotel adjacent to the famous French Quarter in New Orleans, was once a Masonic lodge and temple. Opened in 2001 it contains a single pipe cooling system consisting of wet rotor circulators and fan coil units. Together they provide excellent heat transfer and dehumidification to the hotel's 250 rooms. Dehumidification was a particular concern at first, due to the Big Easy's high humidity levels; the potential for humidity buildup throughout the building especially concerned the local engineering firm Goldstein & Goldstein.

Skeptical at first about the feasibility of the single pipe approach, they now credit it for its ease of installation and maintenance, energy savings and excellent dehumidification over the past three years. Since the hotel's opening the system has functioned flawlessly and maintains a constant 42° F water temperature. "If it didn't," says Stanley Fink of MCC, the mechanical contracting firm on the project, "we'd be the first ones to hear."

Single pipe system links to ground source heat pumps to warm apartments at Canadian resort

At the world-famous Whistler Resort in British Columbia an employee apartment building is heated and supplied with hot water by ground source heat pumps connected to a single pipe system. The system supplies heat and cooling water to fan coils located in each employee apartment unit. Eight ground loop heat pumps, located in the building's mechanical room, pump a mixture of water and glycol through about seven miles of interconnected pipe. Geothermal heat and cooling comes from some 80 holes drilled down approximately 200 ft. below the ground surface to multiple wells.



The single pipe system complements the ground source heat pumps, and there is only a 10° temperature difference between supply and return. By design, the system's heating water temperature is maintained at around 115° F and the system, according to Darrell Anderson of CIR Mechanical of Vancouver, works fine with the lower water temperature.

"The ground source heat pumps in combination with the single pipe system works beyond expectations," he reports. "The system is so sufficient that it even self-purges itself of air, making it essentially self-balancing."

County municipal building is green

A newly completed municipal office building in Oregon was designed and built to LEED Silver Certification and has a single pipe heating system operating within it this winter. The Clackamas County Public Services Building is full of "green" features, right down to its furnishings and choice of plants. Because energy conservation is a critical criteria under LEED certification, Clackamas County and the building's property management group, Johnson Controls, selected the single pipe system for the building's heating system, electing to go with circulators instead of control valves.

"The single pipe system lends itself very well to this type of building," says Laura Ward of Johnson Controls' Performance Contracting Division, which oversaw the building's design and construction and now leases the building to the county. Although initially hesitant about using pumps instead of control valves, the Performance Contracting Division became convinced, after further examination and presentation, that the single pipe system was the best option for the building.

The key to going with the system centered on its lower cost to install and its anticipated energy savings. Energy savings, which also involve automation controls, should begin to pay for themselves in about ten years' time, according to Clackamas County. More immediately, the county estimates that it will save about \$64,000 in the first year of occupancy alone over what it was paying to be in its former building.

Single pipe systems have been installed in a variety of buildings during the past five years and have performed admirably. Even in high humidity areas the system has kept indoor moisture levels at design conditions, providing excellent air conditioned comfort. Design engineers, assisted by a software program specifically designed to make designing a single pipe system simple, fast and error-free, are recognizing the inherent simplicity and lifetime material and energy savings of the system, which match the energy conservation requirements of LEED certification. Mechanical contractors like to work with the system because of its ease of installation and maintenance. Building owners, too, also like the system because of simpler operation, less need for costly maintenance and lower life cycle costs.

More efficient than an air system – using about one half the energy to move BTU's – and requiring less pipe, fittings, insulation and other components than either a conventional two pipe hydronic system or an air system, the "green" single pipe hydronic system has arrived, providing better comfort and lower cost than virtually any other commercial system on the market today.

About the Author

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