Exploring renewed frontiers

Most contractors will tell you that taking on a job midstream isn't an ideal way to make a living. But the fact that a building was halfway through construction didn't faze Walter Lehmann and his team at Frontier Refrigeration and Mechanical Services in Winnipeg.

Lehmann was called in at the last minute when a renovation project in a small rural town ran into some cost and design issues relating to its geothermal system.

The town of Pine Falls had lost a major employer, so as part of the restructuring effort an older school was being converted into an adult learning centre. The 30,000 sq. ft. building had been built in the 1950s with several additions added over time.

By the time Lehmann walked in, the general contractor had already installed and drilled the geothermal wells.

"The loops were drilled, the pipes were in the ground, but nothing was connected," he explains. The plan was always to go with a geothermal system, he says, however, there were a number of issues that had come to light as construction had progressed.

"The building itself presented a number of challenges," Lehmann says. "For one thing it was built on rock, with limited access in some of the crawlspaces. Also, the school was broken into so many rooms, getting the pipes to all of the various rooms would pose a challenge when navigating through the numerous, thick concrete walls that existed throughout this building."

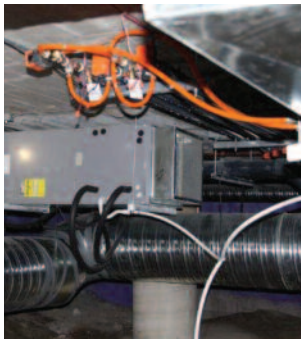
The big problem with all those rooms was that the initial engineering plan for the system was complex and coming in way over budget, he adds. "The original design called for 72 heat pumps and 72 HRVs. The engineering was also very complex in terms of wiring and supply point locations. We were asked to submit a design/build proposal that would get things back on track."

Centralized control

A single mechanical room serves as the central power plant at the adult learning centre, Lehmann explains. "This configuration allowed us to send hot and cold water respectively to all areas to simultaneously heat and cool areas."

Lehmann explains that a traditional two-pipe system would have required direct ties to the geothermal loop to heat or cool. "That would have meant 72 compressors, 72 pumps and a lot of elaborate wiring and ducting. This way we needed far less equipment that could be managed through a single mechanical room, making it much easier for electricians to bring single source power to major loads."

The fact that building was well along the construction path and had a hard stop for completion that was only seven months away presented a major challenge. "We had to come up with a design on the fly that would fit into a tight timeline; get it approved; and get into the building before it had progressed so far we wouldn't be able to cut in for ventilation or run pipes."



He quickly realized that 72 heat pumps and 72 HRVs were much more than would actually be needed with just a few design changes. Instead he proposed a plan that would require only three HRVs and three large "water-to-water" heat pumps strategically located throughout the building.

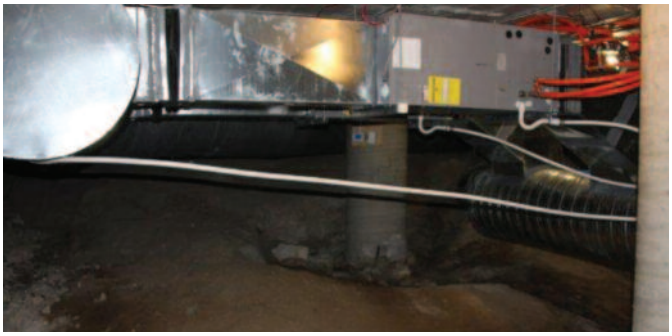
Overcoming barriers

Redesigning and building while other trades were madly racing ahead in the construction stages was yet another challenge for Lehmann and his team. "They couldn't stop construction as we figured out how to do the job," he says.

In addition to the time constraints, there were also installation barriers to overcome. "We had three different crawl spaces to work with and barriers between them, so it was a challenge to get the piping from one part of the building to another." Frontier ended up using three kilometres of four-inch Schedule 80 PVC piping to make the design work.

Equipment placement was another concern. "We had to ensure the classroom areas were quiet," Lehmann says. "At the same time, we needed to place equipment where it would be accessible for maintenance."

Not only is the new system less costly, quieter and more efficient, it is also delivering considerable savings over the long term. Lehmann reports that costs for running the building, taking into account all the lighting, computers and exhaust systems is around $3,600 a month. "The previous design wouldn't have come close to that."



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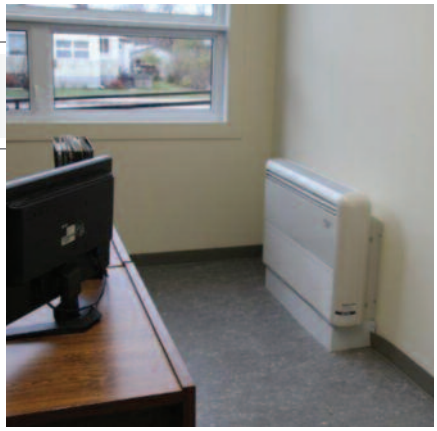
Going for four



Frontier designed a four-pipe system based on a hot and cold loop that continually circulates treated water throughout the building. If an area requires air conditioning, even in winter (e.g. computer rooms), the system can push heat from those areas into the heating loop and heat areas that require heat without the need to draw from the geothermal loop.

One unique aspect of the design is its ability to manage air temperatures without having to constantly draw on the geothermal system. "The HRVs we chose were not the traditional ones that utilize electric re-heat coils to bring the incoming air back to room temperatures. We also incorporated hot water coils that were supplied with hot water from the geothermal hot loop for this incoming and leaving air," he explains. "We knew this would immediately eliminate resistance heat loads and save costs, as well as simplify wiring requirements."

The fan coils were located within each room or adjacent crawls spaces where feasible. These allow the system to circulate hot or cold water through the respective spaces to supply heating or cooling. In cases where crawl spaces are damp, fan coils utilizing both a cold and hot circuit can also perform a dehumidification function.

2 vs. 4

In a two-pipe system, the geothermal loop is connected directly to the geothermal heat pump. In a call for either heating or cooling, the heat pump compressor will run, as will a circulation pump, to either pick up heat or reject heat to the geothermal field.

In a four-pipe system, the heat pumps do not require a reversing valve. Both hot and cold treated water are produced at the very same time when the heat pump runs.

In this scenario the hot and cold energy is moved respectively to the required loads. The geothermal system is only needed to extract or reject heat when these loop temperatures drop.

A thermal flywheel and centralizing the major service in one mechanical room can deliver substantial energy benefits. The fan coils located throughout the building have only the fan, air filters and some relays that will require routine service.

4- Valve Configuration