Paquin Tower
Columbia, Missouri

Retrofit of existing building

- *15-story, 200 units*
- *135,000 square feet*
- *Hybrid ground source geothermal-exchange system*
- *One-pipe design*
- *Elimination of existing boilder*
- *Individual temperature controls in each unit*
- *Geo-exchange used for snow melt and domestic hot water preheat*
- *Reduced outside air and exhaust levels to current code requirements*
- *Utilized energy recovery make-up air unit to provide fresh air to entire building*
- *Replaced existing multi-zone air handler with Variable Refrigerant Flow system for common spaces*

Paquin Tower is a federally subsidized, 200-unit, 137,400 square foot, 15-story high rise independent living community. This residential public housing building was built in 1973 and designated for mixed populations of persons with disabilities and the elderly living in Columbia, Missouri.

In 2010, The Columbia Housing Authority obtained funds from the American Recovery and Reinvestment Act (ARRA) for the upgrade of their aging HVAC system and other energy saving measures. A requirement of the funding was to install a system that would collectively save 30% of their energy costs over three years.

As a part of the energy saving measures, CM Engineering designed a hybrid ground-source heat pump system that replaced the aging hot water boilers and window air conditioners. The new system consists of vertical loop heat exchangers, plate and frame heat exchangers, pumps, piping and controls. Because of limited land on which to drill the bore holes, the design ground loop system was sized to handle the heating load. The design called for forty 500 foot deep vertical bore holes. Because the available land would not allow enough capacity to handle the all the cooling requirements, a cooling tower was added to assist in the dissipation of heat during the cooling season.

The crux of the design was to avoid using the tower in a conventional manner when peak cooling is required, but to devise a control strategy that allows the tower to operate during periods when the outdoor air temperature is considerable below summer design conditions. During these times, not only is the ambient temperature lower, but also the humidity is lower. The combination of lower ambient temperature and humidity vastly improves the tower's efficiency.

Since the load profile of the building was so cooling-dominant, the design added the existing snow melt onto the ground source system. In addition, a domestic water preheat system was also tied into the ground source system. Both these systems provide an energy efficient method of heating their respective loads, but also provided an auxiliary means of removing heat from the ground loop year round.

Outside and exhaust air quantities were evaluated and reduced to current Code requirements. The reduction in outside air requirements had a substantial impact on the energy consumption. The design integrated an enthalpy heat wheel into a new geothermal-exchange make-up air unit which added to the outside air energy savings.

Finally, the existing multi-zone air handling system was replaced with a Variable Refrigerant Flow (VRF) system for the common and administrative areas on the first floor. This system provided individual space temperature control and eliminated the inefficient cooling and reheat operation of the multi-zone system.

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