



*Fossil Ridge High School provides a comfortable learning environment for 1,800 students in Fort Collins, Colo.*

# Energizing Education

By **Craig Watts, P.E.**, Member ASHRAE

**G**rowing population and increased secondary educational needs prompted Poudre School District to build Fossil Ridge High School, a new 290,000 ft<sup>2</sup> high school to serve southeast Fort Collins, Colo. The district wanted the secondary educational facility to provide the community of Fort Collins with a different type of educational space and meet the district's sustainable building goals.

The result was an educational space designed for 1,800 students grouped into three different learning communities of 600. This approach offers close interaction between students and administration. Students gain a sense of belonging to a smaller group while benefiting from the strength of the entire high school population.

By creating a well-designed, cost-effective high school, the school district demonstrates to the local taxpayers that their tax dollars have been used in a way that is worthy of their continued support. As recent studies indicate that optimizing the learning environment for comfort improves students' test scores,

the new school showcases the district's forward thinking approach to the learning environment. Students enjoy and benefit from the new school's environment, and families can be confident that the school district went to great lengths to provide the best learning environment.

## **Innovative and Simple Design**

The design approach for educational buildings can be extraordinary. The requirement to bring in outside air for optimal ventilation rates for students and faculty is in direct conflict with the goal of an energy-efficient building. Outside air requirements

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## **About the Author**

**Craig Watts, P.E.**, is principal/vice president of MKK Consulting Engineers in Greenwood Village, Colo. Watts won a first place 2008 ASHRAE Technology Award.



*At the time of certification, Fossil Ridge was only the third high school in the United States to achieve LEED-NC Silver.*

for this type of building need to change as fast as students change between classrooms. The mechanical engineering firm, MKK Consulting Engineers, implemented two simple but effective ideas: bring in outside air only when required, and use energy recovery systems to minimize the energy required to condition outside air.

**Bringing in outside air only when needed.** Dedicated air units provide outside air that is ducted to each fan coil unit serving a classroom. Using occupancy sensors in the classroom and sensors in operable windows, fan coil operation is regulated. When the classroom is unoccupied or a window is opened, a signal is sent to the fan coil to turn off. As these dampers close down, a pressure sensor in the outside air duct sends a signal to tell the variable frequency drive (VFD) on the air handler to ramp down. The system can change the outside air quantities supplied and closely track actual requirements in the occupied spaces.

**Using energy recovery systems.** Approximately 40% of the total airflow required to condition a classroom is outside air. Once this air is brought into the space, it has to be exhausted from the building. The exhausted air is passed through an energy recovery wheel to preheat or precool the incoming outside air, reducing the energy needed to heat or cool the air.

**Cooling and heating efficiently.** The cooling system incorporates a standard 135-ton chiller coupled with a partial ice storage system. The system makes ice during off-peak hours when electrical rates are lower. The ice is stored in eight large insulated tanks. During the day when cooling loads increase, the cooling system uses the stored ice to provide additional cooling.

Additionally, high-efficiency condensing boilers (up to 97%) are used to generate 140°F heating water. The water is circulated to all of the air handlers and terminal heating units by base-mounted pumps with high-efficiency motors. A fully interactive direct digital controls (DDC) system operates all the equipment to maintain a quiet, comfortable learning environment.



### Systems Working Together

Being a small community in itself, Fossil Ridge High School has several different types of mechanical systems: variable volume air-handling systems for the administration areas and constant volume air-handling systems for the media center, library, gymnasium and other large community areas. Four-pipe fan coil units with dedicated outside air units condition the classroom supply air. As previously mentioned, occupancy sensors and window sensors in the classrooms shut down fan coils when the room is not being used or when a window is opened.

The building has economizers, heat recovery units, split systems, condensing units, constant volume with reheat coils, chillers with ice storage, condensing boilers, full service kitchen with hoods and makeup air units, dust collection systems for wood shops, separate classroom residential kitchens, local exhaust systems placed throughout the building, gas and acid waste for science rooms and a greenhouse. These systems are not complex in a stand-alone application, but operating together in the same building with a full DDC package to achieve the school district's goals of sustainability, maintainability and energy efficiency creates an interesting design.

Nevertheless, the efficient building was designed for easy operations and maintenance. The operation and controls are simple, and the systems are unobtrusive. When people enter the building, they do not see or hear the systems, they only know that they are comfortable.

### Schedule and Budget

The scheduled completion date for the school was June 2004. Due to a massive snowstorm in March 2003, three weeks were added to the schedule. The school opened in July 2004 and was ready for classes as scheduled in August 2004, meeting the district's goal.

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The overall budget for the project was \$38.5 million. The final project budget, with a 5% contingency, was \$42.4 million. This included \$1 million for additional grading, parking lot and ground-work for the site, and \$1.5 million for tennis courts and ball fields that are shared with the City of Fort Collins Parks Department.

### Exceeding Expectations

Fossil Ridge High School shows the engineering community that the use of proven technology, when applied in innovative ways, can produce extraordinary results. Fossil Ridge High School has exceeded Poudre School District's expectations. The school has won multiple awards, met the district's standards, saved money and provided an exceptional environment for students and faculty.

At the time of certification, the school was only the third high school in the United States to achieve the USGBC LEED® for New Construction (NC) Silver rating. The building is ENERGY STAR® rated and outperforms the ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, guidelines for energy savings by 60%.

The building to date, according to the construction manager, has been outstanding in terms of maintenance, cost savings, and operations.

Fossil Ridge's principal said the school's mechanical systems worked overtime during the 2005 summer school session. She thought the systems handled it well, considering that the daytime outside temperature reached into the 100s.



*Eight large insulated tanks store ice made during off-peak hours when electrical rates are lower.*

The school used approximately \$100,000 less in energy costs over the 2004–05 school year than its sister school, Fort Collins High School, of which only one-half of the school is air conditioned. Over the lifespan of the building (50 years), energy savings from the mechanical, plumbing, irrigation, and building lighting systems are projected to save more than \$6 million in operating costs for the district at current utility rates.

Fossil Ridge High School is a high performance building, exceeding the school district's sustainable guidelines, and a model energy performer. The design of the building and site is a clear statement of the district's commitment to environmentally responsible design.●

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