

CASE STUDY

School District
Cedar Rapids, Iowa

School District's Geothermal/Heat Pump/ Fabric Duct Design Serves as Role Model HVAC Retrofit

Engineer's design records utility bill savings of 60 to 65-cents/s.f. versus the \$1/s.f. Annual operational costs for conventional system it replaces.

Cedar Rapids, IA -- The Cedar Rapids Community School District's (CRCSD) long term mission of energy-efficient HVAC building retrofits will save taxpayers millions of dollars in long term energy savings, but also provide optimal learning environments with unprecedented air comfort.

Annual Operational Savings

The state-of-the-art HVAC design by consulting engineering firm, Shive-Hattery Architecture & Engineering, Iowa City, Iowa, uses geothermal technology facilitated by water source heat pumps, energy-recovery outdoor air equipment and fabric ductwork in larger spaces.

Besides, energy savings, the design also brings air conditioning and ASHRAE Standard 62.1 outdoor air compliance to the district's older schools. Retrofitted schools' recorded utility savings of 60

to 65-cents/s.f. versus the \$1/s.f. annual utility costs for the replaced conventional hot water boiler. The design carries higher upfront costs than conventional equipment. However, the payback in energy savings is less than eight years for older buildings that now have air conditioning.

The design was first implemented in the HVAC retrofit of Roosevelt Middle School fifteen years ago. The successful design was later used in the HVAC retrofits of the remaining five middle schools, Truman and Hiawatha Elementary Schools, Thomas Jefferson and Kennedy High School, and most recently at George Washington High School.

Washington's results are still being tabulated. However, the three previous geothermal school retrofits have proven to be 30-40% more efficient than the original systems, according to Tim Fehr, P.E., principal,



Shive-Hattery, which designs HVAC retrofit and new systems for dozens of Midwestern school buildings annually. "To the credit and vision of the oversight committee, they looked at our research data and long-term savings estimates 16 years ago—at a time when two or four-pipe unit ventilators supplied by air-cooled chillers and boilers were the standard for schools—and then progressively made the commitment to use geothermal on every future school HVAC retrofit project," said Fehr.

DuctSox Fabric Innovations

Truman's original geothermal concept remains state-of-the-art today, although Shive-Hattery does tweak the design when innovations are introduced on the market such as DuctSox Fabric Air Dispersion Systems. Truman's open architectural ceiling areas used fabric duct manufactured by DuctSox, Dubuque, Iowa, which was very progressive in 2000.



Fabric duct reduces ventilation material/installation costs and fast-tracks installation time by 60% to assure work completion during a short two-month summer recess. Shive-Hattery specifies fabric duct more frequently today, but now incorporates the industry's latest innovations such as linear L-vents for indoor air comfort, custom colors to match school colors, in-duct tensioning systems for 24/7 inflated aesthetic appearance and other improvements.

Washington features another design tweak that incorporates inline straight and elbow metal duct silencers to attenuate mechanical noise since most heat pumps have short duct runs and are located close to classrooms. "The silencer is a safeguard that guarantees a

quiet learning environment and reduces mechanical noise by 20-dB, which far surpasses the ANSI S12.60 (classroom acoustics) standard," said Fehr, who added that Shive-Hattery will also begin specifying newly-introduced silencers by the textile duct industry on fabric duct runs used in upcoming projects.

Washington's design takes advantage of DuctSox fabric systems many innovations with the use of a custom Warriors red color to match school colors, linear L-vents for draft-less air distribution, and the industry's most recent introduction of the SkeleCore Internal Hoop System (IHS), which maintains an inflated appearance even when the air handler is off. Keeping an inflated appearance and eliminating the distraction and

noise of roll-outs during air handler startup was a game-changer and encouraged more fabric duct use than the past retrofitted buildings, according to CRCSD's buildings and grounds manager.

Fabric is also a good retrofit choice because double-wall insulated round metal duct is 85% heavier for contractors to handle. Also, metal typically requires painting or coatings, and is very labor-intensive when connecting seams or tightly threading through bar joists of open architectural ceilings, according to Fehr.

While metal duct is difficult to remove and is expensively outsourced for cleaning in place, CRCSD's in-house staff has a periodic schedule of cleaning fabric duct runs to provide optimal IAQ, which requires approximately a half-day to disassemble, commercially launder and reassemble.

Another important factor in the CRCSD's post-retrofits energy efficiency is the building automation system. The CRCSD also went the extra mile with their schools' control systems realizing that extensive monitoring and control points create routines and programs that optimize total energy efficiency. According to Fehr.

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