

Category: 6 – Best Building Project | Specialty Contractor (\$6M - \$10M)

Specialty Contractor: Heating & Plumbing Engineers, Inc. (HPE)

Project Name: Colorado College Tutt Library Project

The \$45M carbon-neutral, net zero energy Colorado College Tutt Library renovation project in Colorado Springs, Colorado, sought to achieve modernization of the existing 1926 building—one of the oldest academic libraries in the state—by incorporating high-tech, energy-efficient systems and helping the college achieve its goal of having a neutral carbon footprint by 2020. According to Chris Coulter, Colorado College Associate Vice President of Facilities Services, when this goal was set in early 2008, the college didn't have much of a plan for how to achieve carbon neutrality from an efficiency and conservancy standpoint.

"With this library project, we decided, if carbon neutrality was our goal—why wouldn't we utilize the library as an emblem to our vision as we create it? With respect to engineering, tools, resources, and equipment—why wouldn't we make them the example for who we are and what we're trying to do?" said Coulter.

In addition to a renovation of the existing library, the project included a 20,000 sq. ft. library addition, a new 9,700 sq. ft. fourth level, and the demolition of the 1980's Tutt South addition. The newly-renovated library now houses 94,317 feet of research, community, and technologically-focused space, specifically designed for learning on the college's 'Block Plan' curriculum.

For Heating & Plumbing Engineers, Inc. (HPE), achieving the college's goals involved a degree of complexity our company had never seen. Net zero energy goals included powering the 100,000 sq. ft. building with variable refrigerant flow (VRF) heating and cooling tied to a geothermal field of 80 wells bored 400 feet deep into the campus grounds. Supplementing the building's electrical demand were self-contained, gas powered micro-turbine heat and power generators called CHP's; the CHP's generate electricity for the library and the waste heat is used in the winter as a primary heat source. The project also included a 115-kilowatt rooftop solar

array, a 400-kilowatt offsite solar array, a 130-kilowatt combined heat and power system that utilizes heat waste from industrial processes, and the addition of strategically placed large windows on all levels which allows for the substantial presence of natural daylight. All of these components combined to make Tutt the largest carbon-neutral, net-zero energy academic library in the country.

HPE's biggest obstacle was the extremely aggressive schedule—we began the project on August 1, 2016, and had to have it substantially completed by the start of the following 2017 school year.

"I'm not aware of any project in Colorado that has used this combination of systems; there wasn't a playbook, so you occasionally got yourself into situations where the outcome didn't turn out as expected," said Coulter. "What I thought was remarkable was what HPE *did* about the issues, balancing communication with an unrelenting pursuit of 'getting it right' to make sure that things turned out in a way everyone felt good about. Our team at the college didn't fully understand the complexity; we were more outcome-driven. We had to count on HPE, and they delivered."

Solutions of Special Projects

This project was extremely challenging from a technical standpoint for all trades involved. The geothermal wells and associated underground piping facilitate an exchange of heat from the earth (taking heat from the earth in the winter and returning it the summer); the well water then recirculates in a continuous loop throughout the building for use by the heating distribution system equipment, and HPE's heating pumps and variable refrigerant flow condensing units all utilize this geothermal condenser water. The main mechanical systems for the project included an energy recovering air handling unit feeding a network of seven (7) Mitsubishi VRF heat pump systems for primary building heating and cooling—as well as gas-fired micro-turbine power generators that facilitate building power generation and reject heat back to the heating water loop when in use. These generators then feed electricity back to the utility grid.

"The mechanical system takes the library beyond LEED-certified energy standards into efficiency territory that no other library in the nation has gone," said Coulter. "What HPE did in

integrating all of the combined systems while working with disparate teams on the low carbon and high performance side of things—was truly amazing."

Congested site logistics posed a particular challenge, so HPE shuttled crews in and out of the area, each day, and coordinated just-in-time deliveries of materials. The net zero energy design required HPE to closely manage our controls subcontractor to ensure they understood the design complexity and were able to hit the timelines; HPE also managed all insulation, test & balance, and excavation subcontractors.

Numerous internal and holistic team meetings were helped to keep the project on track, including weekly BIM coordination meetings, weekly MEP subcontractor field coordination meetings, weekly QC meetings, internal site coordination meetings, and more. HPE's field teams also held daily planning meetings and safety meetings.

Excellence in Project Execution / Management & Team Approach

"Our dedicated Quality Control engineer was on-site multiple times per week and maintained the relationship between the engineers, the college, and the field," said Brooks. "It was a full-time job to track the issues and manage resolution on this fast timeline."

HPE utilized a manpower-loaded schedule that was updated as the project schedule changed; three-week schedules were also utilized to help track just-in-time deliveries of fabricated assemblies. These schedules were cross-checked with HPE's CAD and fabrication teams to ensure HPE could meet the specified deadlines.

Because full net zero functionality was incorporated into the college's plan from the start, HPE did not need to make VE recommendations for the project. Where HPE did over-deliver was on project management and field performance.

"We had field guys that were committed to the job and doing whatever it took to hit the dates—with the complexity of this job, we would not have been successful without the specific crews we had on it," said Williams.

"There were a lot of people at the buffet and everyone wanted to have a fantastic meal, yet everyone had a different take on what they were trying to accomplish," said Coulter. "Keeping the communication together and ensuring everyone worked well together...HPE took on that responsibility and masterfully executed the plan to achieve an outcome that everyone is proud of."

Construction Innovations/State-of-the-Art Advancement

HPE's offsite prefabrication, based on upfront CAD and BIM coordination, was integral to the project.

"It was all about sequencing and getting in and out in layers in order not to bury the other subs," said Williams. "This required constant coordination—mechanical, then electricians, then plumbers. We planned a well-orchestrated installation to achieve that."

BIM coordination helped solve another major challenge related to the renovation; the existing building was limited by structural and height constraints, and there was very limited room for all of the disparate advanced systems—including the entire duct system as well as miles of refrigeration and hydronic piping—to meet climate control needs.

"With the VRF solution, every heating zone has its own individual heating/cooling box that is fed with duct work, and every heating/cooling unit had multiple refrigeration lines fed to it," said Williams. "Getting all of it to fit required an immense amount of field collaboration and direct work between our BIM/CAD team and the architects to develop solutions."

Environmental/Safety

Safety risks including the presence of asbestos during the existing building's demolition as well risks associated with connecting 8" round steel piping to an existing high-pressure heating system. This required HPE to implement a hot work permit system, work in confined spaces such as tunnels, and execute lock out/tag out procedures for the piping tie-ins. Additionally, HVAC equipment was hoisted and set on multiple-level rooftops; this was done with very little clearance for the crane as well as complexities involved with working around ongoing

construction. There were multiple safety measures implemented to ensure student safety, including fencing, foot traffic monitors, and a comprehensive crane plan.

HPE exceeded its safety goals through active communication and adherence to our site-specific safety plans and ongoing site audits.

Excellence in Client Service and/or Contribution to Community

Upon completion, Tutt Library became a landmark project for Colorado College; after the renovation and addition, Tutt Library has 94,317 sq. ft. of carbon neutral, net-zero energy, state-of-the-art library space capable of supporting the college's academic mission, 24/7.

College President Jill Tiefenthaler said in an interview upon building completion: "The building is distinctive in many ways, from the environmentally sustainable construction and daily operations to stunning views of Pikes Peak and innovative interior space. It's a great symbol of our values, our history and our sustainability."

"We plan to achieve our 2020 goals and the library is a big part of that; we're really proud of it because it's who we are and it represents what is possible in the Rocky Mountain region," said Coulter. "We're very grateful for the collaboration with HPE, their leadership, and demonstrated commitment to help the college achieve our goals."









