Foothill College Education Center

CASE STUDY

Designing for the Future

Mechanical Engineering
Sustainable Design
Energy Services
Fire/Life Safety
Commissioning

Lionakis
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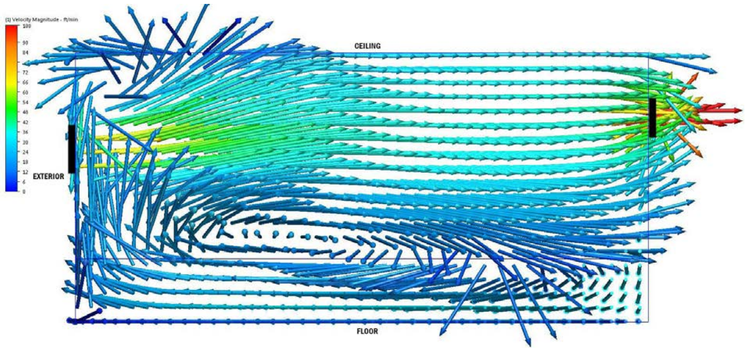
Foothill College Education Center

LEED PLATINUM

The LEED Platinum Foothill College Education Center is the main off-site campus for Foothill Community College offering classrooms, computer labs, 3D printing lab, admission & records and student services support. The two-story 46,882 square foot building is divided into two sections with half of the building housing large classrooms connecting to the building's large atrium. The second half of the building consists of smaller classrooms, offices, conference rooms and additional support areas.

Due to the layout of the building, the mechanical systems were also divided into two separate distinct areas. The large open half of the building is conditioned by radiant heating and cooling slabs with engineered natural ventilation provided by automated natural ventilation terminals (louvers) to provide demand control ventilation based on the CO2 levels inside each classroom. Low power exhaust fans located in the atrium operate based on building pressure to ensure that during periods of natural ventilation that air will always flow from outside in through the classrooms and into the atrium through transfer grills in the ceiling. This helps to provide fresh air throughout the space and ensure that the atrium remains comfortable but is also open and inviting. Due to the layout, smaller nature of the rooms and orientation relative to local wind patterns, the other half of the building is conditioned by a high performance single duct Variable Air Volume (VAV) system served by a rooftop air handling unit (AHU).



CFD Analysis: Performance results for natural ventilation within a typical classroom.

Heating and cooling throughout the building is provided by a modular heat-recovery heat pump with hot water and chilled water storage tanks set to 130°F and 45°F respectively. Each system has primary/secondary pumping with VFDs for maximum efficiency. The heating loop is divided into two sections to ensure that different supply temperatures can be provided to the radiant and VAV reheat systems.

Finally, solar thermal panels are located on the roof of the building to provide domestic hot water to the building through a 130-gallon storage tank with a high efficiency gas water heater providing backup when solar is not available.

ENERGY EFFICIENCY

Significant energy modeling and computational fluid dynamics (CFD) was completed on this project to optimize the natural ventilation system based on local wind patterns and to study the air flow into the building and throughout the classroom and atrium spaces. By providing outside air only when needed the radiant heating and cooling load can be reduced and allow the spaces to stay comfortable while consuming less energy. By also using the natural ventilation terminals to provide free cooling when available, the energy usage of the system is also decreased and allows the radiant system to react slowly to changes in load. Due to these energy efficiency measures the Foothill College Education Center was able to achieve an EUI of 28.5 kBTU/ft2 - year with a **42.4% reduction in energy consumption** compared to California Title 24.

INDOOR AIR QUALITY

The indoor air quality of both portion of the building is monitored by CO2 sensors throughout allowing the natural ventilation terminals to provide fresh air when needed in the classroom spaces and the AHU to increase outside air when office and conference room spaces need additional air which is monitored through an air flow monitoring station on the outside air intake. Due to the nature of occupancy in classrooms, providing direct outside air through the natural ventilation terminals allows for the system to react quickly when a classroom transitions from empty to full.

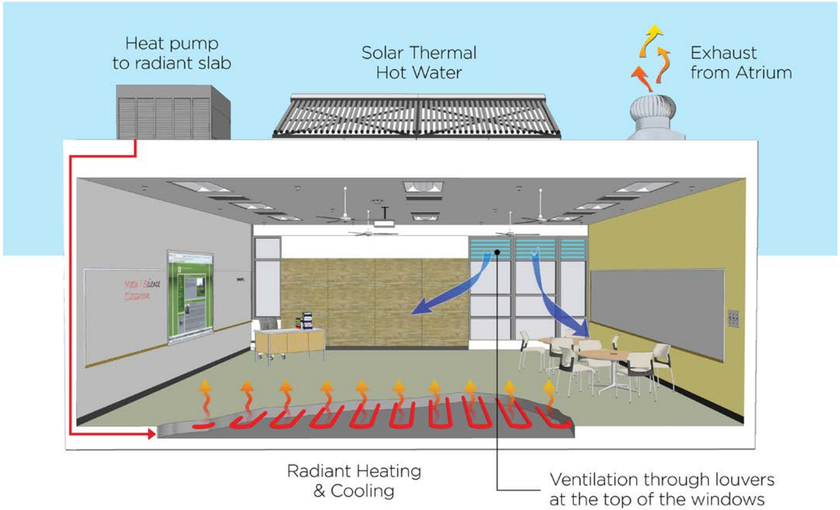
INNOVATION

The College and the design team agreed from an early stage that the Educational Center should be a model of sustainable architecture as well as represent the College's goal of minimizing its carbon footprint. The design team proposed that Bay Area's mild climate allows for effective natural ventilation and passive cooling for the vast majority of the year. However, Title 24 limits the depth of a naturally ventilated zone to 20ft from operable vents, which was not sufficient for the 35ft deep classrooms required for the space programing. To overcome this limitation, Interface Engineering designed an Engineered Natural Ventilation system, which utilizes fan assist to guarantee ventilation flow when no wind is present. The fans are controlled by space CO2 concentration and building pressure, essentially behaving like a demand control ventilation system found in complex VAV systems but without the unneeded complexity and cost.

OPERATION & MAINTENANCE

A standard Facilities Standards Questionnaire (FSQ) was submitted to Facility Personnel at the beginning of the project with questions about the maintenance and operations goals for the project. Additional questions about preferred cooling methods and set points, equipment standards and redundancy, quality of materials, and existing maintenance programs in place are also addressed to ensure that the MEP design is tailored to the building owner's expectations. Easy to maintain systems were selected as this is an off-campus site and maintenance staff would not be located on site.

During the controls points and sequence of operations design development, meetings were held with the owner's representatives, Facility group and Commissioning Agent to review future building operations and answer any questions. Finally, systems were tested and recommissioned early into occupancy in order to ensure that operations met the owner's goals and that the space would be comfortable for the clients while operating at peak energy efficiency.



COST EFFECTIVENESS

The need for a chiller and boiler was eliminated by utilizing a heat pump which resulted in lowered initial costs and increased space in the building by reducing the amount of space required for mechanical equipment and fire rated spaces. Additionally, by utilizing natural ventilation, the added cost for ducting and additional VAV systems in the large classroom area was eliminated and allowed the project to have high ceilings and have a much more esthetically pleasing classroom and atrium areas. Finally, by having the conditioned air from the classrooms to transfer to the atrium, the need for radiant or VAV conditioning in the atrium was eliminated.

ENVIRONMENTAL IMPACT

This project achieved LEED Platinum status on October 2017 with the maximum number of EAc1 points (19 points) for having a 48% reduction in energy cost compared to ASHRAE Standard 90.1. In total, the Foothill College Education Center environmental impact is reduced by 139 metric tons of carbon dioxide equivalent when compared to LEED baseline or the equivalent of almost 342,000 miles driven by an average passenger vehicle.

The building's 48% energy savings equates to a greenhouse gas reduction of 139 Metric Tons annually.

INTERFACE
ENGINEERING