Case Study: Zero Net Energy
La Escuelita Public School

The Oakland Unified School District (OUSD) is one of the largest in California with more than 80 schools and 36,000 students, primarily from low-income communities. Funded by a bond, the La Escuelita Education Center (LEEC) project replaced an outdated campus — consisting primarily of decrepit portable classrooms — with a modern facility. OUSD-LEEC Phase 1 includes a kindergarten, elementary school and district support facilities. The buildings are one and two stories tall totaling 70,000 square feet. The facility was constructed in 2012. Taylor Engineering provided design and commissioning services for the HVAC systems, building automation system (BAS) and plumbing.

The new LEEC campus meets the requirements of the California Collaborative for High Performance Schools (CA-CHPS), including compliance with ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy, comfort standard, and ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality, while maintaining the longstanding OUSD policy of avoiding compressor-based cooling for classrooms and administrative offices. These ASHRAE Standards and OUSD goals were achieved with a combination of building orientation, efficient lighting and daylighting design, and an HVAC strategy that capitalizes on Oakland's Mediterranean climate with its reliable western summer breezes and significant diurnal temperature swings.

The original design concept had the buildings oriented parallel to the streets. For better solar exposure, photovoltaic orientation, shading, daylighting and natural ventilation, the building orientation was reoriented to take advantage of the sun and summer westerly wind.

The building envelope is designed to maximize daylighting, minimize solar heat gain and have good thermal resistance to heat loss in winter. The innovative building envelope design introduced supplemental thermal mass to the walls. In the classrooms and administrative areas, this supplemental thermal mass combines with night flush cooling to charge the thermal mass, providing a dampening of the peak cooling loads. Displacement ventilation using 100% outdoor air for cooling allows much of the heat gain during the day to be relieved from the building without requiring active cooling. The peak cooling loads are further reduced by expanding the comfort temperature range air movement from ceiling fans. The ceiling fans also destratify warm air supplied by the displacement ventilation air outlets in the heating mode. This combination of mechanical techniques allows the LEEC to meet the comfort objectives without compressorized cooling.

The Great Room has a maximum capacity of 720 people for theater-style seating. Cool towers, shown in the image above, colored blue, provide natural ventilation for this high density of people. The cool towers provide evaporative cooling to handle the cooling loads. Along with the other innovations in the classrooms and administrative areas, the cool towers allow the Great Room to meet comfort objectives without compressorized cooling.

TAYLOR ENGINEERING

Project Type

Zero Net Energy Design

Services Provided

HVAC, Controls and Plumbing Design

Commissioning

Completion Date

2012

Innovation

Integrated energy-efficient design

Building mass to dampen diurnal temperature swings

Ceiling fans to expand the comfort temperature range

Displacement ventilation with ceiling fan air mixing in heating

Key Accomplishments

EUI of 29.9 versus an Energy Star Portfolio Manager average of 123 for K-12 Schools

Year-round comfort with no compressorized cooling

Awards

ASHRAE Technology Award

Recognition

PG&E Case Study No. 13, Zero Net Energy Case Study Buildings: Volume 3, 2018

The average energy utilization index (EUI) from the Energy Start Portfolio Manager is 123 kBTUH-per-square-foot-per-year for K-12 schools. The LEEC EUI is 29.9 which is in the top 3% of energy performance for K-12 school projects.

LEEC received an ASHRAE Chapter Technology award in 2017.

Pacific Gas and Electric (PG&E) wrote up LEEC in its Case Study No. 13, Zero Net Energy Case Study Buildings: Volume 3, 2018. PG&E found LEEC operates very close to achieving its Zero Net Energy goals.

More About Taylor Engineering: Taylor Engineering has been pioneering innovative VAV and HVAC control strategies for more than two decades and has proactively worked to share and disseminate these strategies throughout the industry through real projects, teaching and lectures, Title 24 and 90.1 code change proposals, and research. Taylor Engineering was the prime contractor on ASHRAE research project RP-1455, which largely developed the sequences that have been incorporated in Guideline 36, and was also recently awarded the follow up research project RP-1711 to develop high performance sequences for central plants and hydronic systems. Taylor Engineering is also actively involved with multiple research projects funded by the California Energy Commission to study advanced control strategies and radiant energy systems.