A green roof grid system, which covers the majority of the roof deck, helps insulate the building from high temperatures and heat gain.

Variable refrigerant flow (VRF) systems provide HVAC for this California community college's police substation. The facility uses a photovoltaic system to generate 35,000 kWh of energy annually. The substation's tower serves as a solar chimney to create natural ventilation.

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HONORABLE MENTION

OTHER INSTITUTIONAL BUILDINGS, NEW

Making Security Sustainable

BY FRANK SHADPOUR, P.E., HFDP, FELLOW ASHRAE; JEREMY CLIFTON, P.E., MEMBER ASHRAE; JOSEPH KILCOYNE, P.E., MEMBER ASHRAE

BUILDING AT A GLANCE

Police Substation & Parking Structure

Location: Miramar College, San Diego

Owner: San Diego Community College District

Principal Use: Police substation and parking structure

Includes: Building area office; exercise center/exercise area; corridor/transition

Employees/Occupants: 12

Occupancy: 100%

Gross Square Footage: 276,070

Conditioned Space Square Footage: 5,300

Substantial Completion/Occupancy: 2011

Safety and security is a top priority of the San Diego Community College District, and each college has built or upgraded police substations to have a meaningful physical presence with clear student access.

Miramar College's campus in San Diego has more than 13,000 students, and its police substation serves as the central hub for campus safety and security, way finding, and parking permitting. It includes a reception area, conference room, break room, offices, locker rooms, and a secure suspect processing area. The parking structure can accommodate 815 vehicles.

The 5,300 ft^2 (492 m^2), one-story police substation and adjacent 270,770 ft^2 (25 155 m^2), four-story parking structure incorporate elements such as variable refrigerant flow HVAC systems, a solar chimney for natural ventilation, and night flush.

Frank Shadpour, P.E., Jeremy Clifton, P.E., and Joseph Kilcoyne, P.E., are principals of SC Engineers, Inc., in San Diego.

ABOVE Parking Structure Entrance: The four-story parking structure accommodates 815 vehicles.

LEFT Police substation and parking structure is the first LEED Platinum community college facility in San Diego County.

The project used a design/build method with sustainability at the forefront of design and construction. The original target from the owner was to achieve an energy-efficiency performance at least 10% better than California Title 24-2005, *Building Energy Efficiency Standard for Residential and Nonresidential Buildings,* and an additional 12% energy savings beyond a similar facility using ASHRAE Standard 90.1-2004, *Energy Standard for Buildings Except Low-Rise Residential Buildings,* for the police substation.

Modeling software was used to simulate performance throughout the year using ASHRAE design conditions and local utility rates for San Diego (DOE Climate Zone 3B). The final results of the energy model predicted a 45.6% savings compared to California Title 24-2005 and a 47.5% savings compared to Standard 90.1-2004 over a one-year simulation period.

HVAC Systems

The HVAC systems designed for the police substation are variable refrigerant flow (VRF). The condensing units are located on the rooftop of the facility, with the indoor fan coils located within the ceiling space. A single outdoor condensing unit with multiple indoor units and premium efficiency direct-drive fans for space cooling and heating serve the common areas of the substation. The system allows heat recovery between multiple zones and simultaneous heating and cooling for maximum efficiency. Return air from offices, conference rooms, and other nonhazardous areas are fully ducted back to the associated indoor unit. Zone temperature control is accomplished with a temperature sensor.

A single outdoor condensing unit serving two indoor units, each with 100% outdoor air for space cooling and heating, were provided for the locker rooms. The locker rooms are served by a dedicated VRF system separate from the building's other conditioned spaces to meet the unique demands of occupancy and allow for maximum efficiency. All air-conditioning systems and exhaust fans have direct digital controls (DDC). Indoor units are internally controlled to manage the heat recovery functions, and the entire VRF system has output to the building DDC system.

The police substation is mechanically ventilated with ventilation rates designed in accordance with ANSI/ASHRAE Standard 62.1-2004, *Ventilation for Acceptable Indoor Air Quality.* All the building's outdoor air is introduced through 17 VRF fan coil units, with airflow monitoring provided by each. In addition, CO_2 sensors are supplied in the breathing area of all densely occupied spaces.

The facility uses passive conditioning systems. Each zone, equipped with operable exterior windows, can shut down the indoor VRF unit and condition the space with natural ventilation, providing an additional level of occupant comfort. The tower element of the police substation serves as a solar chimney to create natural ventilation through the building. Louvers in the tower's upper level allow warm air to rise by convection and escape to the outside. At the same time, cooler air is drawn in through vents on the lower level, replacing warm air with cooler air even after the sun has gone down.

The indoor space temperature is maintained by the VRF fan coils, which are capable of providing the temperature setpoints specified in ANSI/ASHRAE Standard 55-2004, *Thermal Environmental Conditions for Human Occupancy*. The fan coils are tied to wall thermostats to allow shared group thermal comfort control. Of the 10 individual workspaces included in the police substation, five are equipped with thermal comfort controls. All areas are kept within the acceptable range of 72°F (±2°F) (22.2°C [1°C]) and 50% relative humidity.

Green Roof and Walls

Great emphasis was placed upon the facility's architectural design to reduce the HVAC load, maximize natural ventilation, and simplify serviceability and maintenance. A green roof grid system, which covers the majority of the roof deck, helps insulate the building from high temperatures and heat gain. It uses modular panels for ease of installation, roof access, and maintenance.

In addition, a green screen covers the west elevation of the parking structure, which further contributes to lower ambient heat gain, both within the police substation and the parking structure. The vegetation contributes to a microclimate central to the facility's passive thermal and natural ventilation design. Additionally, the green roof and wall systems help reduce the heat island effect and complement the benefits of the pervious pavement used in the parking area.

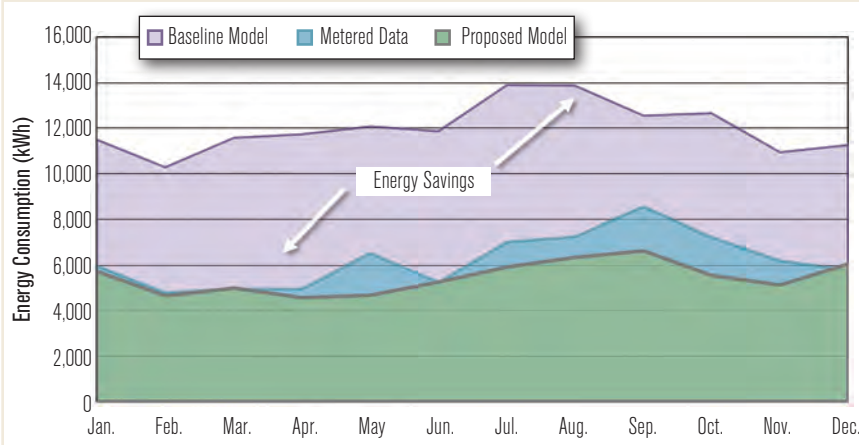

FIGURE 1 Twelve Months of Energy Data. The integration of heat recovery and natural ventilation contributed to the excellent annual energy performance demonstrated in the graph above.

Building Automation System

The key to the overall building performance was tying in the operation of old and new technologies. An advanced building automation system (BAS) tied the ancient design principals of natural ventilation to a state-of-the-art variable speed HVAC system. By using web services and

Advertisement formerly in this space.

predictive analytics, the BAS finds the optimal mode for the building's operation based on the day's weather forecast. If diurnal temperature swings are sufficient, the BAS will flush the facility with cool night air prior to a day that requires mechanical cooling. The result is a seamless climate control strategy that takes full advantage of the benefit of the moderate coastal climate.

The DDC system was used as a tool for commissioning by creating meaningful dashboards and trending capabilities for continuous benchmarking and ongoing commissioning of selected processes wherever possible. The physical layout of the equipment was arranged to provide ample access and proper path of travel for maintenance and service.

Project Costs

The project was budgeted at $17.9 million, but delivered at only $16.7 million. The cost savings for this project were mainly due to a well-conceived, coordinated design through integrated project delivery. The design and construction team collaborated with the owner and end users to maximize value and reduce waste.

Various HVAC systems, along with payback analysis and total cost of ownership figures, were presented to project stakeholders. The most favorable solutions were selected through a collaborative effort, with input from all parties. The HVAC systems considered included chilled beam, positive displacement, natural ventilation, and a number of other innovative, energy-efficient systems.

Each system was evaluated on its own merit to reduce initial and operational costs as well as total cost of ownership. Ease of maintenance and serviceability were also critical factors in the decision-making process. This process resulted in an energy-efficient, easy to maintain facility built at the lowest possible initial investment.

The design team took advantage of financial incentives offered by the local utility company, San Diego Gas & Electric (SDG&E), as part of its "Savings by Design" program. SDG&E awards incentives to teams that make the extra effort when integrating energy efficiency with exceptional design. The reduced energy use for this facility returns a cost savings of approximately $4,184 annually.

Conclusion

By incorporating innovative technologies and pursuing the highest LEED Platinum, the design/build team for the Miramar College Police Substation and Parking Garage was able to deliver a facility with a greatly reduced carbon footprint.

Sustainable Design

The San Diego Community College District's original goal was to provide a facility that would achieve, at a minimum, a LEED Silver rating. The design/build team aimed higher. The project submitted for 53 potential points, in addition to the system's prerequisites and achieved all 53, earning LEED Platinum. It is the first community college district project to achieve this level of certification in San Diego County.

An array of other sustainable design features factor into the building's LEED Platinum design, including:

- On-site renewable energy from photovoltaic (PV) systems, which generate 35,000 kWh of energy annually;
- Terra cotta rain screens that create a vented façade and increase building envelope energy efficiency;
- Curtainwalls that have horizontal exterior siding on the south, vertical fins on the east, and a large glazed area facing north;
- Use of reclaimed water for flushing toilets/urinals and irrigation;
- Low water use plumbing fixtures, leading to an estimated 6,640 gallon (25 135 L) (56%) savings;
- Suspended ceiling "clouds" that enhance acoustical performance while serving as reflectors for daylight;
- Demand response for energy efficiency;
- Daylighting to reduce loads;
- Demand control through CO_2 sensors;
- Certified finish materials;
- Renewable and recycled flooring;
- Low-emitting casework materials;
- A recessed, interactive flat screen panel in the reception area of the police substation that informs visitors of the building's sustainable features, and reinforces Miramar College's sustainability goals; and
- Solar chimney with motored dampers for natural ventilation.

Acknowledgments

This submission was generated using A/E final construction documents, LEED documentation, a case study provided by the project General Contractor, McCarthy Building Companies, Inc., and data provided by the San Diego Community College District. ■