Green in the Golden State

Marian Keeler

A design-build team with an eye for efficiency, quality and conservation define the Gold LEED™-certified Department of Education building in Sacramento.

California's recently completed Department of Education Building, at Block 225 of the Capitol Area East End Project (CAEEC), occupies an urban infill block in Sacramento. Formerly a parking lot, this site now houses one of the city's most sustainable and progressive buildings.

California's Department of General Services developed Block 225 as part of a larger coordinated complex that includes four additional buildings and two parking structures. The six-story building at Block 225 houses offices and support services for the Department of Education. It is surrounded on three sides by small commercial and medium-density residential buildings. The majority of its 479,000 sq. ft consists of office space. The rest of the building includes a day care center, food service, retail uses, below-grade parking and a large multi-purpose boardroom. The lobby, featuring stone salvaged from the Sacramento Library, embodies the elegance of surrounding civic buildings from which CAEEC draws its context.

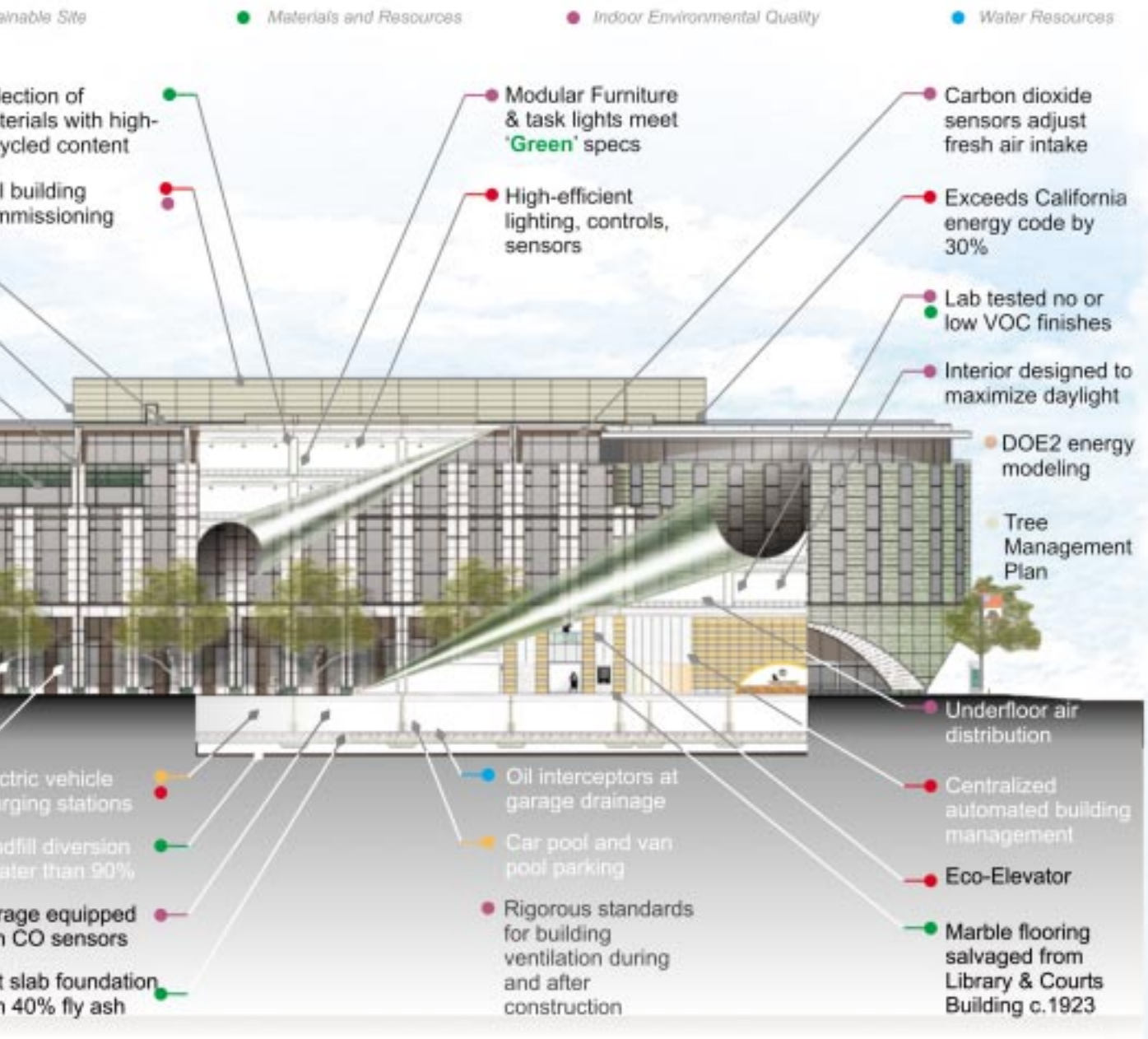
In January 2003, the building won a U.S. Green Building Council LEED™ version 2.0 gold certification for the project—only the second project in California and the largest state office building of its type to receive this designation at the time.

THE GREEN PLAN

CAEEC Block 225's story is one of team collaboration that resulted in a successful green building. In 1999 the State of California held a competition to select a design-build team for a large new office-building complex. The State elected to procure the project through a modified or "bridged" design-build delivery system. Master planning and development of general design concepts, specification, and performance standards assured that the project would both meet the program criteria and allow the design-build team to use its expertise to develop core building systems.

In addition, the State established rigorous green-building criteria in the competition requirements, with 20% of the selection criteria points allocated to green-building enhancements. The State's "Green Team" of representatives from several agencies oversaw the drafting of the RFP's green-building requirements and participated in the sustainable oversight for the entire complex. In response to the RFP, Hensel Phelps Construction Company (HPCC) formed a team committed to the notion that CAEEC Block 225 would be California's most sustainably designed office building.

"Our goal was to design and construct a building that was exemplary in its commitment to sustainability while exceeding the owner's expectations for



design, technical and energy performance," said Greg Gidez, project manager for Fentress Bradburn Architects. The State's decision for a bridged design-build delivery approach allowed the team to select design consultants and sub-contractors committed to the same goals. "Every aspect of the design and construction process was analyzed to determine ways to enhance the sustainability of the project," Gidez said. HPCC Vice President Jon Ball agrees that the teamwork approach made sense. "A unique characteristic of this project was the collaborative manner in which the project team and the subcontractors exchanged ideas in a completely open and non-defensive manner. The direct result was a consummate green building."

The team developed over 140 strategies, including 124 green-building enhancements in three categories: energy conservation and efficiency, indoor air and environmental quality, and resource (site, soil, water, materials) efficiency. All of these enhancements were added by team consensus and were within the original project budget and schedule. The HPCC team was awarded the project in December 1999, and immediately began implementing the Green Plan developed during the competition process. Beneficial occupancy was complete in July 2002.

STEEL SUPPORTS SUSTAINABILITY GOALS

Steel was a practical choice given the design-build nature of the project. "Steel could be ordered sooner without going through bidding, as required by the standard design/bid/build delivery method," according to Cliff Paul, P.E., of Paul Koehler Structural Engi-

Because steel is lightweight, the structural and foundation systems are half the weight of an equivalent concrete structure.

The elliptical shape of the front lobby extends up through four stories.

neers. "Steel ended up saving time and money because of this process. With the help of the design-build method, after the team was awarded the project, they were able to issue a mill-order package within six weeks because they were 50% complete with the design at the time of award."

Design-build also allowed the architects and engineers to work directly with the steel fabricators and detailers to develop the most cost- and schedule-effective solutions. This close working relationship during development and detailing of the systems resulted in better coordination and a reduced delivery schedule. Design-build accelerated the project, the steel frame was delivered early, and 10 months were shaved off the original 36-month construction schedule. The savings from reduced overhead and general conditions were re-invested into the project in the form of additional green enhancements.

Most importantly, steel was the material of choice because of its sustainable aspect. Structural steel today is 90% recycled on average, and the project also incorporates reinforcing steel, steel deck and steel stud framing. Because steel is lightweight, the structural and foundation systems are half the weight of an equivalent concrete structure, thus improving material savings. The high use of recycled steel also reduces the need to mine and smelt ore, thereby reducing the amount of embodied energy in the material and associated environmental costs such as the emission of greenhouse gases.

The structural system used for the Block 225 building consists of a steel-framed structure with $3^1/_4$" lightweight concrete over 3" composite steel deck at the second floor through the roof. The first floor utilizes $5^1/_2$" hardrock concrete over 3" composite steel deck. All floors are designed using composite steel beams with headed studs. The beam sizes range from W8×10 to W24×279. Column sizes range from W12×50 to W14×342. The building uses more than 3000 tons of recycled steel, equating to 12.25 lb. per sq. ft. The beam-to-beam and beam-to-column connections use ASTM A490 bolts for all shear-plate and double-angle connections.

The lateral system consists of eccentric braced frames from the first floor to the roof level. The first floor is used as a transfer level to keep the braced-frame web members out of the desired free-flowing garage below. The lateral forces are transferred to basement shear walls on four sides via the concrete-over-steel-deck floor diaphragm.

Other steel features include a 60'-long, 10-deep truss designed to span over the enclosed dock area. The truss supports four floors and a roof above, plus a precast façade. It also allows for mechanical louvers at the building perimeter.

A 46"-deep plate girder spans 65'-0" over the main lobby in order to provide for a column-free space. This beam supports steel beams which cantilever up to 15'-0" to form an elliptical floor plate. The cantilevered beams (W24×279) are spaced at 10'-0" o.c. and support a column load at the cantilevered end from three floors and a roof above. In the same area of the lobby, an 8"-diameter extra-strong pipe was fabricated as an elliptical shape in two directions. Its approximate 120' length gives the granite façade at the front lobby a backing member to attach to.

The fire protection used on the main steel members is a spray-on Monokote. Only the beams had to be fire-proofed, as the steel deck is designed to have a fire rating.

ENERGY USE REDUCTION

Energy conservation and efficiency was a key goal for Block 225. The team sought innovative ways to save energy dollars and minimize life-cycle costs. Among the 48 energy enhancements are technologies such as an under-floor air distribution system (UFAD), and building-integrated photovoltaic panels on the penthouse skin, donated by Sacramento Municipal Utility District. Other load-saving strategies, such as lighting and power/occupancy sensors within workstations, offices and conference rooms, significantly reduce energy consumption. DOE 2 energy analyses indicated that the project would be about 35%-40% more energy efficient than required by CA Title 24 1998, with a yearly energy-cost savings of about $185,000.

Alternative modes of transportation to and from the complex are encouraged. The building is near public transportation, and below-grade parking includes alternative vehicle re-fueling stations, and preferred carpool and vanpool parking.

INDOOR AIR QUALITY

Design for good indoor air quality (IAQ) was paramount. "Knowing that this building would be occupied for a large portion of the day by state employees and by children in the day care center, we elevated the issues of indoor air quality to the top of the sustainability measures list, and followed through on the implementation through the construction and post-occupancy phases," said SMWM Principal Anthony Bernheim.

To limit sources of indoor air pollutants and particulates, building materials were selected based on their ability to meet project-specific indoor-air quality-performance guidelines. To meet Special Environmental Requirements Specifications Section 01350, independent laboratories conducted emissions-chamber testing for volatile organic compound (VOC) emissions. Section 01350 prescribes that interior building materials be tested for emissions of chemicals of concern: carcinogens, reproductive toxins and other potentially harmful VOCs listed on the California EPA's OEHHA (Office of Environmental Health Hazards) list. VOC concentrations for each of the materials are modeled based on the project (volume of air, room size, amount of materials and air exchange rates) and are used only if the concentrations are below specific levels. SMWM and the project team developed Section 01350 concurrently with scientists from the Lawrence Berkeley National Laboratory, the State Department of Health Services, the State Green Team, and Hal Levin of the Building Research Ecology Group. It continues to be the template for numerous other projects within the State.

As part of the Building and Indoor Air Quality Commissioning process, multi-point tracer gas air testing (sampling of the indoor air of the building) took place at the end of the construction phase, after furniture move-in, and at one year after occupancy, to verify that the indoor air-contaminant con-

A 46"-deep plate girder spans 65'-0" over the main lobby to provide a column-free space.

To limit sources of indoor air pollutants, building materials, such as the natural stone and marble flooring, were selected to meet project-specific indoor air-quality guidelines.

centrations did not exceed typical values in comparable buildings. The ventilation performance of the mechanical system will also be studied to assure that the levels of compounds and contaminants in the building are decreasing as expected.

In addition to conserving energy, the UFAD system mentioned earlier positively impacts IAQ by introducing filtered air at the floor level while exhausting at the ceiling, away from the occupant. Individual floor swirl diffusers allow occupants to control the laminar airflow. Outside air economizers introduce up to 100% outside air and the ventilation is designed to exceed ASHRAE standards. The Center for the Built Environment in Berkeley has made CAEEC Block 225 a case study to assess increased user productivity as a result of the UFAD system.

Another strategy to improve the quality of the indoor environment was tp cluster offices and enclosed spaces around the building's core, leaving the building's perimeter open to daylight and views. Transoms and clerestories distribute light to the interior, and many workspaces have direct views. The effects of construction on air quality were minimized by a 30-day flush out, and the development of an IAQ management plan. Materials were installed in the proper sequence to avoid the desorption (sink effect) of VOCs to more porous materials. As a result of these combined strategies, the U.S. Green Building Council has recognized the building for its innovative approach to IAQ management.

RESOURCE EFFICIENCY

Resource efficiency is the third sustainable goal. In seeking to conserve and optimize resources, the team considered the issues of site, water and materials in relation to the building's consumption of natural resources.

To make the site more resource-effective, the program required underground parking. Other site strategies engaged the neighborhood to incorporate an efficient outdoor space. An interpretive pocket park located on the CAEEC Block 225 site contains native plant species and employs Integrated Pest Management (IPM) practices to control pests. Recycled organic wastes from compost tumblers process waste from the landscape and building, and provide support for the park. The park is also an educational instrument, with signs and guided tours for visitors to learn more about the site's sustainable practices.

Water conservation is important in Sacramento's dry climate. Sensors on plumbing fixtures contribute to water-use reduction for the building. Grey water collected from water fountains and daycare lavatories is treated and used as make-up water for the pocket park's fountain. High-efficiency, subsurface, low-water irrigation systems prevent evaporative loss and a minimum of run-off. With these strategies, on-site water use was reduced by approximately 67% and building use was reduced by 36%.

Other green-project strategies reduce natural resource use. These include the installation of recycled content and recyclable building materials in conformance with the California State Agency Buy Recycled Campaign (SABRC). SABRC is a procurement policy for California agencies mandating recycled content levels. Because the team placed high measure on these recycled content goals, CAEEC Block 225 earned a LEED Innovation and Design credit for installing materials with exemplary levels of recycled content. Another resource-conserving strategy was the implementation of a construction-waste management plan that diverted 95% of construction waste from the landfill. Forty-percent fly ash was used in the concrete mat slab, the foundation system chosen over driven piles.

GREEN IS AS GOOD AS GOLD

The project's LEED gold certification is an indicator of success. "We're especially pleased that we were able to achieve certification without increasing the budget, which helps prove that green buildings can be achieved within budget constraints," said Jim Ogden, senior associate and project manager for construction manager 3D/I.

In June 2003, the building won a Pacific Coast Builder Conference's Gold Nugget "Best in the West" Award in the category of Sustainable Non-residential Project. CAEEC Block 225's achievement can be attributed to the cooperation among members of the design-build team and with the client. The State's "Green Team" met monthly with the project team during construction to oversee the development of the environmental specifications, materials testing, commissioning and LEED documentation.

The level of State participation brought an element of partnership that permeated through the design and construction process. "The point of partnering is to build relationships," said Seth Boles, HPCC project manager. "Every day you're going to have something come up in the field that you need to resolve. How well you work together as a team will depend on how well you deal with the things that come up." Formal partnering sessions with the client, construction manager and team members had the effect of energizing day-to-day functioning. "It was a dream of a project," Ball recalls. "When I need to refer someone to a project where the project execution was flawless due to the collaboration among stakeholders, I consistently use CAEEC Block 225 as the model." Undoubtedly, CAEEC's green story could not have been told without this spirit of genuine collaboration.

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Dreyfuss & Blackford Architects, Sacramento

GREEN BUILDING ARCHITECTS
SMWM, San Francisco

STRUCTURAL ENGINEER
Paul Koehler Consulting Structural Engineers, Scottsdale, AZ

ENGINEERING SOFTWARE
RAM Structural System

STEEL FABRICATOR, ERECTOR AND DETAILER
Schuff Steel Company, Phoenix (AISC member, NEA member)