ZERO NET ENERGY VERIFIED CASE STUDY

West Berkeley Public Library | Berkeley, CA
Credit: David Wakely Photography 2022

OVERVIEW FACTS

Building Size: 9,400 SF

Location: Berkeley, CA

Construction Type: New Construction

Completion Date: December 2013

Building Type: Public Assembly

CA Climate Zone: 3

Energy Use: Electric

Construction Cost: $5.5 Million

West Berkley Public Library

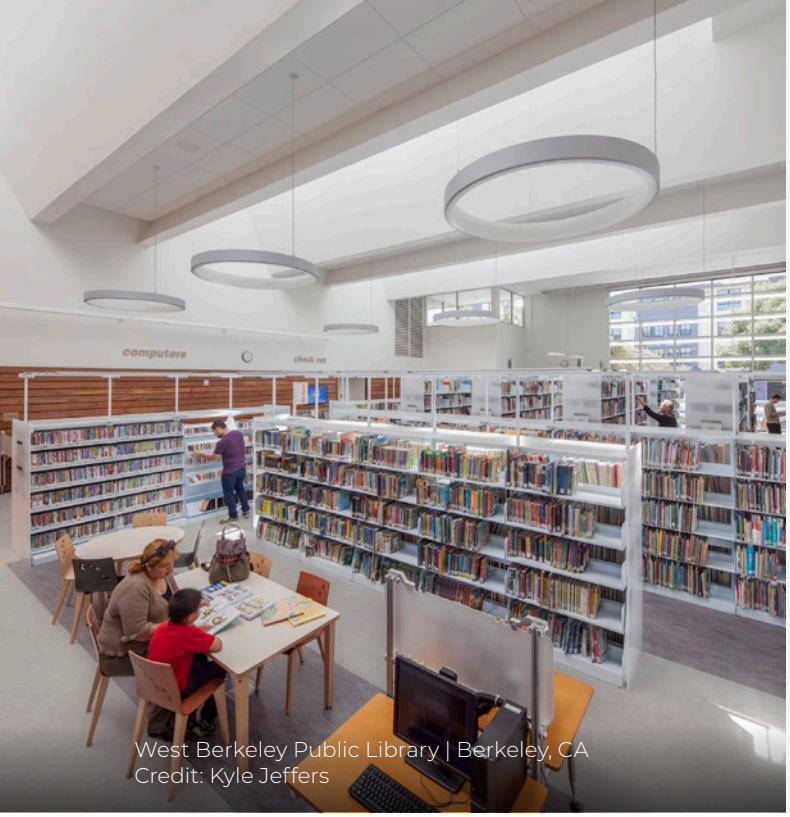
West Berkeley's high-performance branch library, in operation since 2013, has achieved deep energy efficiency through careful design and by deploying passive strategies and innovative technologies.

The building's ultra-efficient systems enable it to use a relatively small onsite solar PV array to produce more energy than it consumes on an annual basis.

Planning and Design Approach

The project team worked closely with the City of Berkeley and library staff throughout the project. The design was highly responsive to the climate and site context and used complex modeling to optimize the building performance within the tight urban environment. By focusing on passive strategies first, the design team was able to dramatically reduce the anticipated energy consumption of the building, which made the task of generating enough energy to balance the consumption much more cost-effective and achievable.

The design of the library fully embraces both passive strategies and a high-tech approach to building operation. The control system integrates the radiant heating and cooling, demand controlled ventilation, daylight sensing, and electric lighting systems, as well as the photovoltaic and thermal solar energy systems. Involving mechanical and electrical engineers



West Berkeley Public Library | Berkeley, CA
Credit: Kyle Jeffers

MEASURED ENERGY STATS*

23	28	-5
Building's Total EUI	Renewable Production Intensity	Building's Net EUI

*2015 Data. More-current PV production and total EUI data are unavailable due to a supplier issue.

2021 EV Charging Data:

28,791 miles delivered

(3.66 kBtu/sf/yr; assuming average 0.35 kWh/mile)

Site Energy Use Index (EUI) kBtu/SF/year

The Energy Equation: The building energy use minus the renewables production equals the net energy of the building. Buildings may be 'Getting to Zero' and have a net EUI above zero. If renewable production exceeds energy use its net EUI is below zero (negative) and it is creating surplus energy.

in early design sessions allowed the team to explore strategies reflective of local climate and building type and fostered a truly integrated design process.

Energy Modeling

The design team used energy modeling as a tool to deliver the best building possible. The incremental costs for modeling work (about $43,000) were offset by a grant from the Pacific Gas and Electric Company (PG&E) Savings by Design Program, the precursor to today's California Energy Design Assistance Program. The suite of modeling work included climate, solar, daylighting, energy, and computational fluid dynamics (CFD). Investment in CFD studies to analyze air and heat flow resulted in an optimized natural ventilation system with minimal comfort issues.

Energy Efficiency Strategies and Features

ENVELOPE

The library envelope provides excellent thermal and acoustic insulation, maximizing energy performance and comfort for occupants. A triple-paned, store-front glazing system along noisy University Avenue helps manage acoustic performance. The vestibule at the entrance maintains pressurization in the building and minimizes the escape of warm or cool air. The envelope also included a cool roof with an R40 insulation value and R31 walls even considering the thermal bridging at the microlam studs. Further, the building was built on a 12" structural slab, with a single layer of rigid insulation between the 4" radiant slab and the 18" mat slab. All conduit was run beneath the mat slab.

PROJECT TEAM

Architect: Harley Ellis Devereaux

Civil Engineering: Moran Engineering

Structural Engineer: Tipping Mar

Mechanical, Electrical, Plumbing Design Engineer: Timmons Design/Harley Ellis Devereaux

Landscape Architect: John North Roberts

Sustainability Consultant: Harley Ellis Devereaux

Audio Visual: Smith, Fause & McDonald Inc.

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Credit: Kyle Jeffers

Lighting and Daylighting

The library takes full advantage of natural light with a series of skylights and a large glass facade designed to eliminate the need for artificial lighting during the day. Given the operating hours of the library, this reduces lighting energy to near zero. Electrical lighting is tied to daylight sensors, which is used to supplement the daylight on cloudy or darker days.

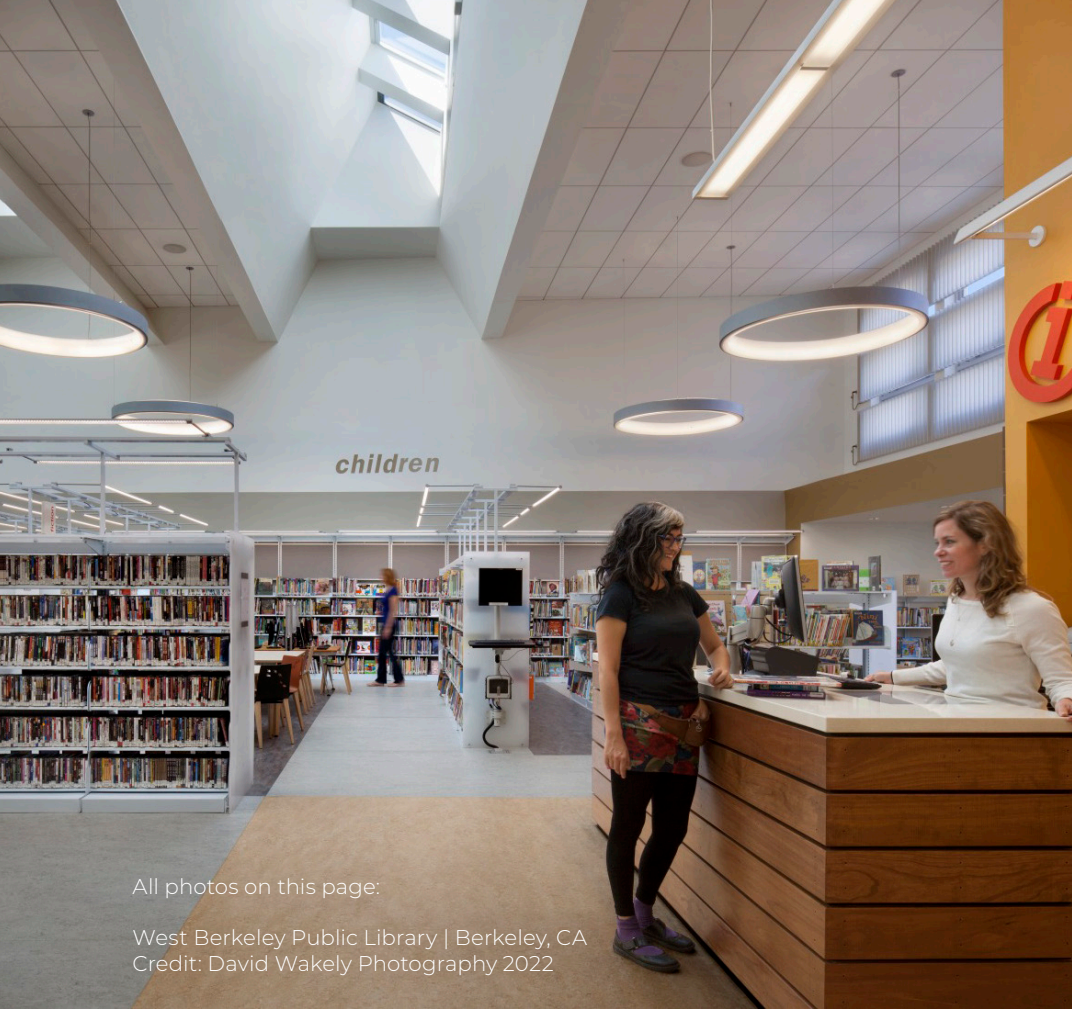
Heating, Ventilation, and Air Conditioning (HVAC)

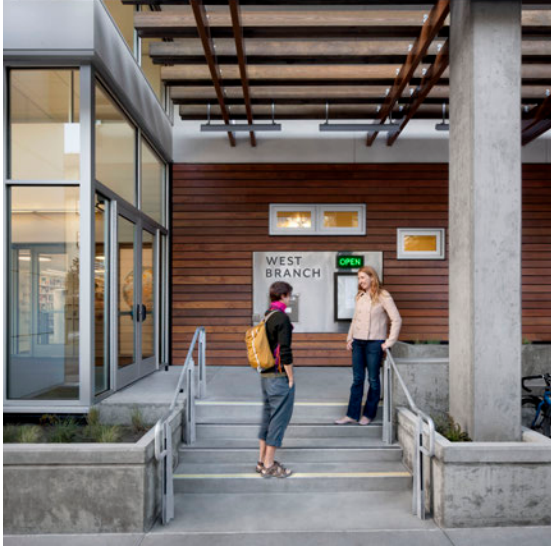
The library's primary space conditioning system is a hydronic radiant slab used for both heating and cooling. The radiant system is only used during peak loads when comfort conditions can't be met by purely natural or assisted natural ventilation alone. To supply the radiant system, the solar thermal collector and heat pump operate in a primary-secondary function, with the heat pump supplementing the solar collector as needed to meet water temperature set points.

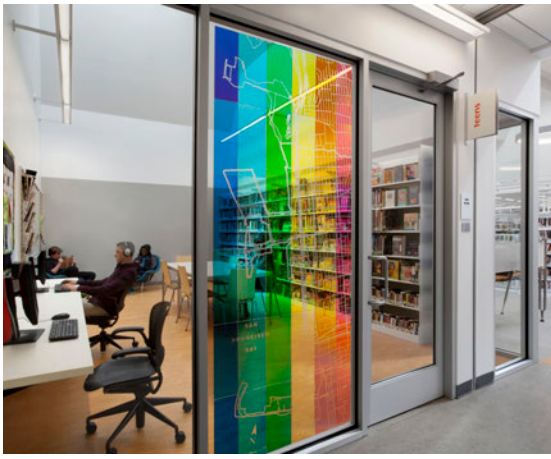
Natural ventilation is an important part of the design. Manually operable windows are in a position where patrons and staff can easily use them. Automatically controlled windows are located high in the space and have preheating hydronic convectors at the openings to prevent cold drafts caused by cold air entering the space in winter.

"A lot of care went into this building, almost everything you see isn't just for looks. It has a specific function."

Gerard Lee, Project Architect,
Harley Ellis Devereaux







All photos on this page:

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Plug Loads

Since this building was replacing the library's old location, they had the opportunity to study the existing plug loads to have a more accurate input for the energy model. Laptops are charged by staff and checked out to users to help limit plug loads and allow the staff to keep track of the energy consumed by the computers. Public electric outlets are provided at reading tables in the stack area and in wall outlets in the meeting room for patrons to use.

Controls

An integrated building automation system (BAS) controls the photovoltaic system, lighting, radiant heating, and radiant cooling. The HVAC system is controlled using several modes of heating and cooling, with various levels of natural ventilation, fan-assisted ventilation, and radiant heating and cooling. The systems are optimized for energy consumption and the lowest energy operating mode is used to satisfy the heating, cooling, and ventilation loads. If loads can't be met, the system incrementally incorporates fans and eventually the heat pump as needed to meet the loads with minimal energy use.

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Credit: Harley Ellis Devereaux

CEDA

California Energy Design Assistance (CEDA) Program

Public buildings like this library, as well as private-sector projects, are eligible for design assistance through the CEDA program. CEDA provides complimentary custom energy modeling to analyze energy efficiency options and potential energy savings for new construction and major alteration projects. Based on these projected energy savings, projects can qualify for financial incentives to offset the costs of energy-saving measures.

Email **CEDA@willdan.com** or call 855-502-3914 for more information.

Pacific Gas and Electric Company®

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