TWO PROJECTS
TWO PATHS TO NET ZERO

CITY OF BERKELEY
WEST BRANCH LIBRARY

SOLAR THERMAL PANELS
PHOTOVOLTAIC PANELS
NATURAL VENTILATION:
OPERABLE WINDOWS AND VENTS
CONTROLLED DAYLIGHTING
RADIANT HEATING AND COOLING
AUGMENTED BUILDING INSULATION

HARLEY ELLIS DEVEREAUX

CALIFORNIA STATE UNIVERSITY AT SAN MARCOS
FACILITIES BUILDING
CITY OF BERKELEY
WEST BRANCH LIBRARY

DESIGNED FOR
ZERO NET ENERGY
LEED PLATINUM
Understand site and climate

- Temperate climate
- Heating degree days: 1481
- Cooling degree days: 365
- Noisy street
- Solar access constraints
- 1920’s library building on site
Early adoption of net zero as goal:

Optimize renewables → Target EUI

Renewables:
Photovoltaics
Solar Thermal DHW and Radiant Heating
Optimize envelope, orientation, daylight, natural ventilation → Reduced loads

Temperate climate → greater significance of lighting and plug loads
Manage plug loads:

Variability of plug loads over time → Importance of occupant involvement
OPPORTUNITIES

- Client enthusiasm for net zero
- Temperate climate
- PG&E incentives

CHALLENGES

- Initial cost limitations → Net zero maintained, but façade design value engineered
- Fee not adequate to cover net zero design services
- Lack of integrated software for accurate energy modeling, Title 24, and incentive applications
  - Comfort level of Architects/Engineers/Builders with alternative building systems and methods
DESIGNED TO MEET
PASSIVE HOUSE STANDARD
WITH ZERO NET ENERGY

Understand site and climate

- Cooling climate
- Heating degree days: 368
- Cooling degree days: 1811
Understand site and climate

Optimize renewables $\rightarrow$ Target EUI

Optimize envelope, orientation, daylight, natural ventilation $\rightarrow$ Reduced loads

Manage plug loads
Enlist occupant participation

Understand site and climate

Use Passive House Standard to establish EUI

Implement integrated Passive House strategies to optimize envelope, orientation, daylight, natural ventilation $\rightarrow$ Reduced loads

Optimize renewables

Manage plug loads
Enlist occupant participation
Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 1994 ft²

<table>
<thead>
<tr>
<th>Applied Method</th>
<th>Monthly Method</th>
<th>PH Certificate:</th>
<th>Fulfilled?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Space Heat Demand:</td>
<td>3.84 kBTU/(ft²yr)</td>
<td>4.75 kBTU/(ft²yr)</td>
<td>Yes</td>
</tr>
<tr>
<td>Pressurization Test Result:</td>
<td>1.00 ACH₅₀</td>
<td>0.6 ACH₅₀</td>
<td>No</td>
</tr>
<tr>
<td>Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):</td>
<td></td>
<td>38.0 kBTU/(ft²yr)</td>
<td></td>
</tr>
<tr>
<td>Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):</td>
<td></td>
<td>5.64 BTU/(ft²hr)</td>
<td></td>
</tr>
<tr>
<td>Specific Primary Energy Demand Energy Conservation by Solar Electricity:</td>
<td></td>
<td>3.52 kBTU/(ft²yr)</td>
<td></td>
</tr>
<tr>
<td>Heating Load:</td>
<td>4.63 BTU/(ft²hr)</td>
<td>4.75 kBTU/(ft²yr)</td>
<td>Yes</td>
</tr>
<tr>
<td>Frequency of Overheating:</td>
<td>%</td>
<td>80.0 °F</td>
<td></td>
</tr>
<tr>
<td>Specific Useful Cooling Energy Demand:</td>
<td></td>
<td>4.75 kBTU/(ft²yr)</td>
<td></td>
</tr>
<tr>
<td>Cooling Load:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use Passive House Standard to establish EUI

- Significance of primary (source) energy
- Approach towards process loads
Implement integrated Passive House strategies to reduce loads:

- Airtight envelope
- Continuous insulation
- Minimized thermal bridges
- Balanced ventilation with heat recovery

Optimize renewables:

Campus parking lot

Manage plug loads

Enlist occupant participation:

Student monitoring of campus energy use
PASSIVE HOUSE:
PUSHING THE ENVELOPE

Airtight envelope at 0.6 ACH50
PASSIVE HOUSE: PUSHING THE ENVELOPE

Use of THERM software to minimize thermal bridges
PASSIVE HOUSE: BUILDING COMPONENTS AND SYSTEMS

Windows
Heat recovery ventilators
OPPORTUNITIES

• Client enthusiasm for Net Zero and Passive House
• Potential lower cost of Passive House
• Sharing of campus resources
• Involvement of students and community in studying feasibility of project

CHALLENGES

• Low cost of energy
• Cooling climate = challenge of internal loads
• Lack of integrated software for accurate Passive House energy modeling, mechanical system sizing, Title 24, and incentive applications
• Comfort Level of Architects/Engineers/Builders with Alternative Building Systems and Methods
• Lack of inexpensive Passive House building components and systems
• Perceived lack of indoor/outdoor continuity with Passive House designs