FEDERAL FACILITIES SYMPOSIUM

Moving toward a Zero Carbon Future

The IDeAs Z2 Design Facility:

Z2 = net Zero energy,

Zero carbon emission

OCTOBER 1, 2008
Speakers

Scott Shell, AIA, LEED® AP
- Principal
- EHDD Architecture
- Principal-in-Charge

David Kaneda, PE, AIA, LEED® AP
- Principal / building owner
- Integrated Design Associates, Inc.
- Electrical engineer
Presentation Overview

- First decision
- Key concepts:
  - Architectural
  - Mechanical
  - Electrical
- Cost of “Z Squared”
- Q & A
First Decision: LEED® Platinum or Z Squared?

What if….?

…we designed an all electric, super efficient building and then offset all of its power requirements with PV’s?

Scott Shell, AIA
conceptual design charrette, September 9, 2005
Architectural / Structural / Landscaping Concepts

- High user comfort
- Reuse the existing building
- Upgraded insulation (R-19 walls, R-30 ceiling)
- Daylight and views
- High performance glass and skylights
- Electro-chromic glass
- Operable windows
- Drought tolerant planting
- Direct reuse of demo materials
- 60% reduction in existing site paving
- Building Integrated PV entrance canopy
- Building Integrated PV cool roof
- Access to public transportation
- 50% Fly ash concrete topping slab
Key concepts: Reuse an existing building
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Key concepts: Reuse an existing building
Key concepts: Provide high user comfort
Key concepts: Natural ventilation
Key concepts: Maximize daylight and views
Key concepts: Spectrally selective glass

- Visible transmittance = 63%
- Solar Heat Gain Coefficient = 0.31
- U-value = 0.29 winter night / 0.27 summer day
- Light to solar heat gain ratio = 2.33
Key concepts: Control solar heat gain
Key concepts: Increased wall and ceiling insulation

- R-19 walls
- R-30 ceilings
Key concepts: Drought tolerant landscaping
Key concepts: **Mechanical / Plumbing Concepts**

- Radiant heating
- Radiant cooling
- Ground source heat pump
- Natural ventilation
- Dedicated OA air handler
- CO₂ sensors - demand ventilation
- Displacement ventilation
- Night time purge
- Photocell powered sensor low flow faucets
- Low flow dual flush toilets
- Waterless urinals
- Heat pump waste heat capture for warm water
Key concepts: Radiant floor heating and cooling

Occupant comfort is:

- 50% radiation
- 30% air movement / air temperature
- 20% evaporation
Key concepts: Ground source heat pump

- Earth stays constant at about 57°F
- Pulls heat from the earth in winter
- Puts heat into the earth in summer
Key concepts: Reduced water usage
Key concepts: Electrical / Lighting Concepts

- High efficiency light sources
- Astronomic time clock
- Task/ambient lighting
- Individual occupancy sensor task lighting controls
- Occupancy sensor ambient lighting controls
- Mesopic lighting concepts
- Light pollution reduction
- Daylight switching photosensors
- Daylight dimming photosensors
- Photovoltaic system
- Upsized wiring
- High efficiency transformer
- Energy star equipment
- Occupancy sensor based plug load control
- Wireless data
- VOIP

computer model

actual photograph
Key concepts: High efficiency light sources
Key concepts: Automatic lighting controls
Key concepts: Daylight harvesting
Key concepts: **Minimize plug loads**

- High efficiency equipment
- Software based shut off
- Occupancy based controls
- Security system based shutdown
Key concepts: BIPV for net 100% of energy consumption

- All electric building
- Net zero energy
- Zero carbon emissions
Analysis: PV system incentives

- PV Capacity 30 kW DC/ 28kW AC
- 42,707 kWh / year

Estimated PV Cost:

- $255,000 installed cost ($8.50/watt)
- $72,602 CEC rebate BIPV ($0.34/kWh x 42,707 kWh/yr x 5yrs)
- $31,858 tax on CEC rebate (35% fed tax, 8.854% state tax)
- $76,500 30% federal tax credit
- $89,250 accelerated depreciation* (35% federal corp tax)
- $48,506 cost of system after 5 years

* calculation does not include the time cost of capital

- the cost after rebates, tax credits and depreciation is about 19% of the installed cost.
- Energy savings at $ 0.16 / kWh = $6,833/year
- Payback is about 7.1 years
Analysis: Estimated additional cost for “Z Squared”

Key differences from a conventional building:

- $20,000  cost of upgraded glass
- 97,500  cost of radiant mechanical system over traditional system.
- 38,000  cost of concrete for radiant floor
- 48,500  cost of PV systems (after rebates and tax incentives)

- $204,000  total
- 244,800  total with soft costs

- $4,100,000  total cost of building
- 6.3%  premium to build a net zero energy building
How we did it

- Have a client who is committed to sustainability and willing to take risks.

- Hire a team who is experienced in sustainable design.

- Bring together the entire team during conceptual design. Minimize energy consumption first, size PV’s second.

- Focus on daylight harvesting.

- Use radiant floors.

- Look for LEED points after the design is completed. (The building will probably be Gold or Silver.)
Project team

for more information: [www.z2building.com](http://www.z2building.com)
David and Stephania Kaneda, Owner

EHDD Architecture, Architects
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Tipping and Mar + Associates, Structural Engineers
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Carroll Engineering, Civil Engineer
[www.carrollengineering.com](http://www.carrollengineering.com)

MPA Design, Landscape Architects
[www.mpadesign.com](http://www.mpadesign.com)

Hillhouse Construction, General Contractor
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