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PRACTICE

Pioneering Zero-Zero Building Creates Ultra High Energy Efficiency

Extraordinary building uses zero energy, produces zero emissions

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Contributing Editor

How do you . . .
transform a nondescript one-story building into one of the country's first innovative z-squared commercial structures?

Summary:
In a former 1960s-era bank building in San Jose, Calif.—once windowless and resembling a solid concrete block—a forward-thinking electrical engineering firm is creating a high energy-efficient sensation. From below ground to the roof, Integrated Design Associates Inc. (IDeAs) has designed a structure that, if it performs according to their calculations, will produce zero carbon dioxide emissions and use zero electrical energy, to be what is believed to be one of the first "z-squared" commercial buildings in the country.

The firm's recently completed 7,200-square-foot headquarters, the IDeAs Z-Squared (Z2) Design Facility in San Jose, is designed for high energy efficiency and sustainability—to provide 100 percent of its own net energy requirements through renewable energy. On the roof, skylights flood light into the interior and building-integrated photovoltaic panels convert sunlight to electric energy to meet all of the building's net energy needs. Inside, water warmed by the earth provides heat, walls lined with tinted windows ward off the sun's rays, sensors switch lights on at dusk, and equipment turns itself off when the last employee goes home.

This inventive facility, designed by EHDD Architecture and constructed by Hillhouse Construction, sits on a 34,000-square-foot site. It will burn no fossil fuels, thus use no net energy off the electrical grid, and will produce no carbon emissions or greenhouse gases that could harm the environment. It is proving that such a sustainable building is not a dream of the future, but a dream that is attainable right now.

"That was a big issue for us, to show that it is possible now to do a zero carbon building," says David Kaneda, AIA, founder and president of IDeAs. The consultancy, which moved in last month from offices in Santa Clara, Calif., specializes in integrating electrical and lighting systems into sustainable, energy-efficient projects. "The message we wanted to send is that we can do z-squared today. It is not 10 years out. There is such a big problem with global warming, and with the technology we have today, we can do it."

Letting sunlight in, but not the sun's heat

"We created this building first to be designed around energy. It will be extremely energy efficient," says Kaneda, whose company has created net zero energy and zero carbon emission designs and projects certified to LEED® Silver, Gold, and Platinum levels. Kaneda's goal is to earn LEED® Silver certification with this facility. "Daylight is a key part. We designed the building to allow in the right

amount of daylight, but not so much that it heats up the building."

Windows along the east wall feature electrochromic glass that turns tinting on or off using a photosensor to reduce both glare and the cooling load. Skylights and tinted sliding glass doors feature infrared and UV filtering glass. An overhang on the building's south side also controls summer solar loads.

"The building was designed so the space we are working in is all day-lit," notes Kaneda, of the ambient light augmented with skylights and supplemented with high-efficiency fluorescent lamps suspended over the studio space. "We have enough daylight on a normal day that we don't have to turn any lights on at all. Right now, all of the electric lights are off. It's totally day-lit now and it's really nice."

Electric lighting is used in the evening or on rare heavily overcast days, and occupancy sensors turn off general lighting when no occupants are present.

Radiant floor system

The building interior is heated and cooled with a radiant floor system. This high-efficiency design was a collaboration between Rumsey Engineers and Johnson Controls. Warm or cool water supplied by an electric ground-source heat pump flows through underfloor polyethylene tubing to condition the building.

The facility's geothermal system takes advantage of the earth's natural, constant below-ground temperature of roughly 57 degrees Fahrenheit. "A ground source heat pump will pull heat out of the ground or dump it into the ground to heat or cool the building," Kaneda says. "In the summer, water is pushed through the ground and used to cool the building, and in winter it does just the opposite. It is the most efficient way to space condition the building." Outside, under a 10,000-square-foot area of open landscape reclaimed from a parking lot, water is pumped through pipes stacked at six and four feet underground. This heats or cools the water, which then warms or cools the building.

Automatic controls and sensors regulate plug-load energy use

Inside, high-efficiency office equipment, sensors, and automatic controls manage energy consumption. "Architects and engineers often think they can't control plug loads," says Kaneda. "But we have control over what gets plugged in, and we found there are ways designers can reduce that number." Kaneda replaced computer monitors with flat screens and plugged desk task lights and stereos into occupancy sensors that switch off nonessential equipment when occupants leave their spaces.

The team discovered an energy abuser in phantom loads—minute amounts of current pulled by equipment when in sleep mode. "The worst offender was a large-scale plotter for plotting drawings," says Kaneda. "It

used 30 watts, 24 hours a day, seven days a week. It goes on standby and sits there and doesn't really turn off. We asked ourselves, how could we save that energy? We came up with a system that works when you arm the security system. It sends a signal to the electric panels and it switches off the circuit breaker."

The photovoltaic system, which uses two types of PV panels to generate the building's electricity, is sized to match the calculated load. If the facility is generating more electric power than it can use, the building will return the energy to the utility grid. The facility will stay hooked up to the grid in order to push any excess power back out onto the street or to use the power from the grid if necessary. "We will push the electricity out the front door so other buildings can use our clean power instead of dirty power [produced by the electrical grid]," notes Kaneda.

The extraordinary building will be a learning laboratory for professionals and researchers to study how sustainable buildings function. Some areas deliberately show the guts of the building such as radiant floor manifolds and ceiling conduits so designers can see how such buildings are put together. Self-monitoring systems examine the building's operations and develop data to measure and fine-tune its performance.

"We have set up multiple overlapping control systems so we can test out the system. It is a lab for us," Kaneda says. "The system measures every circuit and collects data on it. We want to develop a Web site that will post information on how the building is performing so we, the public, and researchers can get to it and look at how the building performs."

"Our goal is to educate other designers and make this project replicable so that others can emulate and surpass what we have accomplished," Kaneda concludes. "Ultimately, that's the only way we are going to make progress in controlling global warming."

Reference:

Design Team:
Architect: EHDD Architecture
Contractor: Hillhouse Construction
Mechanical Engineer: Rumsey Engineers, Johnson Controls
Electrical Engineer: Integrated Design Associates (IDeAs)
Structural Engineer: Tipping and Mar
Landscape Architect: MPA Design
Civil Engineer: Carroll Engineering.

Captions
1. The IDeAs Z-Squared (Z2) Design Facility in San Jose.
2. The facility provides 100 percent of its own net energy requirements.
3. The "before" picture of the building's incarnation as a bank building.
4. Sunshades control direct solar gain.
5. The interior is lighted with a combination of daylight and high-efficiency fluorescents.
6. Architect David Kaneda, AIA, shows off the building's PV array.