Design Strategies Maximize Energy Efficiency in Science Buildings...
Design Strategies Maximize Energy Efficiency in Science Buildings

Published January 31 2007

Proper Planning Results in Significant Cost Savings

This article discusses the first five of 10 design principles that can make a significant difference in the operation of a research facility.

Savings possible in labs per year using existing technology,” notes Joe Collins, a partner at Zimmer Gunsul Frasca Partnership in Portland, Ore. “Research institutions looking to reduce their operating budgets and their environmental footprint need to know what design strategies are going to get the best returns.”

Skyrocketing energy prices and an explosion in the construction of research facilities, there is more pressure on institutions to implement sustainable design features. Collins and Paul Mathew, a staff scientist at the Lawrence Berkeley National Laboratory, have created a list of Top 10 strategies ideal for use by building owners, architects, and engineers to affect costs and energy efficiency.

Strategies are already being used with success at facilities throughout the U.S., including Portland State University, Oregon Health and Science University, Duke University, Oregon State University, and the University of California at Berkeley and Santa Barbara.

Ins and Mathew are including their strategies in the design of the Li Ka-Shing Center, a $150-million biomedical research laboratory building which will be constructed at the University of California, Berkeley beginning in the spring of 2008. It is imperative to include these strategies during the early design stages so it is nearly impossible to implement them after a building is constructed.

Focus on Programming

The first strategy involves programming, which represents the initial opportunity to influence operating costs. Each program has unique opportunities to explore initial energy savings in areas such as program grouping/consolidation and the recovery of heat.

Can be smarter about the buildings we design and we can achieve a more amenable outcome just by asking a few extra questions during programming,” Collins. “Ask about the different types of spaces and which will have high or low hours of operation, similar utility requirements, and similar need to open day/night. We can then group spaces together that have similar requirements so we can be more efficient in our design.”

Planned Earth Systems Science Center at Oregon State University is an example of how programming can be used to boost energy efficiency in other parts of the facility. The facility’s massive data center, used to conduct climate and atmospheric research throughout the world, will produce a tremendous amount of heat. This energy will be used to heat other areas of the building, such as the perimeter around the windows. The facility will also include water tanks for testing remote submersible vehicles. A heat exchange system will allow heat to be stored in the water tanks and then used elsewhere when necessary.

Biomedical Research Building at Oregon Health and Science University illustrates how effective programming can augment energy efficiency. Due to a steeply sloping site, most of the mechanical systems are located near the animal facility, which is on the first floor. Process wastewater from the cagemen and other lab uses flows by gravity into a heat recovery tank then passes through a heat exchanger to preheat the incoming water for rest hot water and lab hot water.

Push the Envelope

Glare control and control over radiant energy can be achieved through effective exterior wall designs.
ne Appropriately

der to appropriately zone a facility, it is critical to separate the lab spaces from the non-lab spaces and then set levels of conditioning and control accordingly. The non-lab spaces represent opportunities to condition and utilize energy more efficiently.

- Lab spaces can re-circulate air and labs can’t. If you jumble them, it is 'acting as design systems to treat each differently,' says Collins. "If these aren’t zoned differently, more energy is required. There is also the potential to isolate heavy load program elements on a process chilled water loop in x to avoid designing the entire supply air system for a unique point load."

my clear distinction is noted between the lab areas and the non-lab areas in design for the Li Ka-Shing Center at UC Berkeley. In particular, the lab isolation requirements are decoupled from the cooling requirements. The design also takes into consideration the comfort of occupants while providing a working environment.

Northwest Center for Engineering, Science and Technology at Portland State University displays a noticeable distinction between the different functional areas of the building. For example, in a stairwell area, a stack effect is created re cooler air comes in at the bottom and warmer air is exhausted at the top to advantage of natural ventilation.ing appropriately came easy at the Marine Sciences Building at the University of California, Santa Barbara where the building occupants want to be reected with the outside environment. In their offices and some other non-lab areas, researchers prefer operable windows and the natural ventilation afforded he building’s design.

sh the Envelope

architects, we want to think carefully about the enclosure of the buildings we gn and make sure we are capitalizing on climatic forces and what nature ide," says Collins. "For instance, we want to look at the sun and how it effects the building in terms of where it might provide high heat load and how the rotation and massing of the building can help overcome that."

essential to utilize strategies that will reduce electrical load, as well as its visual and thermal comfort, especially when 90 percent of operating costs directly related to staff. Glare control and control over radiant energy from the slope can be accomplished through effective exterior wall design, which imizes natural ventilation and daylighting in the appropriate zones. The UC ta Barbara, Bren School of Environmental Science and Management uses ror screening devices to provide shading and to help direct natural breezes.

design for the Li Ka-Shing project utilizes a corridor as a buffer zone seen the high western solar loads and the research space.

r environmental considerations include air quality—how clean or dirty is and its corrosive effects. Facilities at the University of California, San Diego Santa Barbara must consider materials to deal with the effects of salt in the re is this romantic idea of being one with the environment," says Collins. "As gners and engineers it is our job to make a building actually work with the environment and not cause additional problems to any extent possible."

‘ucture for Daylighting

exterior walls should be designed to take full advantage of available light. Higher window head heights make deeper daylight penetration possible, requiring less artificial lighting for ambient illumination. Adjustabror shading devices can be used to control glare.

use a rule of thumb of about two to 2½ times the height of glass on the ror wall as the effective depth for penetration for daylighting," explains ins. "Lighting can be eight to 20 percent of the total electrical load. If you at the total cost of owning and operating a building over its lifetime the al cost to build it is about two or three percent. Most of the money goes into it takes to pay people to live and work in that building. If you can achieve a 15 percent increase in efficiency or retention of staff, that pays big tands and access to natural light is a significant part of that equation."

ing height, the location of main duct runs, and the structure on the building’s ror must be considered when designing to optimize use of daylighting. If is can be moved to the center of the building where the ceiling height is lower the perimeter beams can be turned up, thereby allowing high fenestration for story below, it is possible to achieve the same level of daylighting with lower floor-to-floor heights.

labs at the Leichtag Center at the University of California, San Diego are led with natural light admitted through full-story glazing and a ceiling that es upward to receive it. Exterior screening is utilized on the south facade to rglare. An atrium at Stanley Hall at UC Berkeley provides plenty of natural into the heart of the building. Adjustable natural wood louveres and shading used to manage glare.

re are going to be good stewards of the environment, we have to take a more
A holistic approach in designing buildings,” says Collins. “As designers who are serious about designing sustainable labs, we need to hit energy efficiency really hard.”

Next in the Series

Part II of this series, Paul Mathew, a staff scientist at Lawrence Berkeley Laboratory, will discuss the remaining five strategies for achieving maximum energy efficiency by including specific design features in the planning of academic science buildings. The article will discuss scrutinizing air changes, using low-pressure drop design strategies, avoiding the unnecessary oversizing of systems, steering clear of systems that require simultaneous heating and cooling, and commissioning the building to ensure it is operating as intended.

Tracy Carbasho
Collaborative Spaces Bring Diverse Researchers Together - 11-29-2006

- Recruiting in the Private-Sector vs. Academic Research Environments
- Features of Research Facilities Can Steer Decision-Making for Recruiting Talent - 10-11-2006

- Simon Fraser University Designs "Plug-and- Play" Technology Complex
- Build It and They Will Come—and Pay for the Fit-Out - 11-15-2006

- Translational Research Facilities Present Key Design Challenges
- Effective Facility Design Can Enhance Bench to Bedside Research Applications - 10-18-2006