Economic change prompts inherently green solutions

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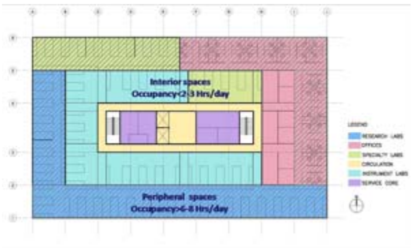

Fig. 1. Smart design maximizes daylighting by putting the most frequently occupied spaces in zones where they can benefit from natural light. All diagrams: FOLIO Architects.

After years of debt-fueled extravagance, Americans have taken a sobering hit where it hurts the most: their paycheck, pocketbook and retirement funds. Gone are the days when one could swipe a credit card for lavish purchases one could not afford or make a business decision without careful cost analysis. As a consequence of perhaps the most severe recession since the Great Depression, public funding has dried up and venture funding has become almost impossible to acquire.

In such an uncertain and harsh economic environment, building a new lab facility is one of the riskiest stakes an organization can take on. Most such facilities in the commercial sector are built in anticipation of, rather than in response to, a product's success. Planning for such facilities needs to begin several months, if not years, ahead of a product launch. The probability that an organization will use its facility for its intended function or product is always hard to predict and stays uncertain in the short term, and this is true in both the public and private sectors.

But as *Time magazine* stated this past April, “This is the end of the world as we've known it. But it isn't the end of the world.” Every crisis brings with it an opportunity. It is time for us to start living, and designing our facilities, more wisely. Today's state of affairs has presented us with the opportunity to examine the rationale behind “industry standard practices” and “rules of thumb” and evaluate if they still have value.

While there has been a growing emphasis in recent years on green practices, many of these have come as an “add-on” design strategy, often at significant additional cost. This article is focused on employing simple, innovative, common sense-based cost saving strategies, as an integral part of the design, to achieve sustainable and economical design.

Passive design strategies

Orienting the building and spaces within the building to maximize natural light to people-intensive spaces can help improve the quality of the space while reducing energy costs. Natural light typically penetrates 20 to 25 ft into interior space. Light penetration further into interior spaces can be augmented by using higher level windows, reflective ceiling profiles and interior windows. Thus, while wet labs and open offices can be placed on the perimeter, individual offices and interior instrument labs can get the benefit of natural light and view as well (Figs. 1 and 2).

Fig. 2. Clerestory windows, sloped ceilings and interior glazing can all help distribute natural light to spaces deep within the building.

Currently, skylights are often used to bring natural light to interior spaces. However, these bring issues of excessive heat gain and glare. An appropriate alternative would be to use north light which affords even general light without the added burden of heat or glare (Fig. 3).

Another simple strategy to limit heat gain in buildings, while also improving the visual quality of the space, is to add plantings. Deciduous trees on the south and west facades will shield the sun during the hot summer months and allow sunlight penetration during the cold winter months. Horizontal sun shades on the south façade and vertical sun shades on the west facade will control heat and glare. Where site area is limited to disallow plantings, trellises or vertical screens with deciduous vines are just as effective (Fig. 4).

Fig. 3. Designs that make the most of north light can achieve the benefit of illumination without undue heat gain and glare.

Local design strategies specific to the area should be examined to evaluate their applicability. One such strategy, long abandoned due to our growing reliance on mechanical systems and complex controls, is that of natural ventilation. In the San Francisco Bay area, where evenings are significantly cooler than the day, exterior thermal mass along the building perimeter would create a 6- to 8-hr delay in the penetration of heat to the interior. Night time ventilation through windows or ducted systems, using 100% cool outside air, could then be circulated to flush the heat out, leaving a much cooler interior (and minimal cooling loads for the next day).

Space utilization

The disconnect between present purpose and original motivation is found in many current labs, designed years ago for a traditional wet lab. This is partly due to the exponentially faster nature of technology proliferation in research; current demands for many lab spaces were unforeseen. Labs designed as wet labs have over time been steadily inundated with increasing number of instruments, leaving limited or no bench space for prep work. See the December 2009 digital edition for a discussion of better space utilization, including equipment use and writeup and storage space: http://www.rdmag.com/General/Laboratory-Design-News-Archive/

Utility systems/air change rates

MEP costs contribute >50% of lab construction costs today vs. only 30 to 35% 30 years ago. This increase has been driven by the increase in reliance on mechanical systems as well as the complexity of controls associated with them. The traditional rule of thumb has been to design labs with 100% outside air with 12 to 15 air changes per hour (ACH). Numerous studies have been done, but there is no clear evidence that higher air change rates have resulted in improved worker health and safety.

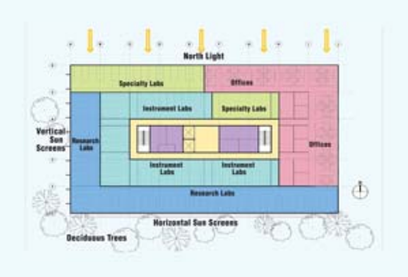

Fig. 4. Landscape design should work in tandem with building orientation and glazing to ensure intelligent handling of natural light.

Reducing ACH offers most clients a very high potential for annual energy savings. The benefit encompasses not only operating costs, but also capital construction cost savings, since reduced ACH leads to a reduced need for equipment and ductwork.

A sample cost saving analysis is as follows:

- Reduce rate from 15 ACH to 10 ACH.
- Assume a 20,000-ft^2 facility with 55% labs (11,000 ft^2, with a 9-ft ceiling height).
- 15 ACH requires 22,500 ft^3/min (cfm).
- 10 ACH requires 15,000 cfm.
- Initial infrastructure cost savings at \$32/ft^2 = \$352,000.
- Annual energy savings at \$5/cfm = (22,500-15,000 cfm) x \$5 = \$37,500.

What makes it reasonable and sensible to consider reducing lab air change rate today is that lab practices over the years have changed dramatically. We use lower quantities of chemicals and many of them are less hazardous. Also, better lab practices limit open use of volatile solvents, and there are more closed and contained processes and procedures. Procedures that may have been performed on the open bench 25 years ago, are now conducted in powder-weighing hoods and fume hoods. There are fewer fume hoods, improved hood performance at lower exhaust volumes and better technology for controlling air volume.

While today's companies and organizations face tightened budgets, they still need to support the changing and growing infrastructure required for ongoing research and development. Apart from direct research expenses, the highest capital and operating cost element to support research is the cost of the facility. Therefore, any improvement in the efficiency and operation of the facility will make a significant impact on the company's bottom line.

As each client strives to conserve finite resources, senior management is looking for bottom-up innovation to lower costs and add strategic value. Creative solutions that improve productivity by maximizing existing space efficiency and improving the work environment will go a long way in helping a company ride out current challenges and come out ahead from both a financial and a sustainability standpoint.

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