A Green Building

The Good, the Bad, the Neutral

By Richard L. McDermott

In 2010, it's good to be Green. If you are Green, you are up-to-date and doing the right thing. Every institution would like to have at least one Green building in its inventory. And delivering Green Facility Management is an important credential in today's market. Okay, then why am I not comfortable signing up for everything Green? You know, "Going boldly, where practically everyone has gone before." In the stampede to sustainable design, I'm thinking there are probably some Green features that have not received a lot of scrutiny, and some probably do not apply to all projects.

Question: How do you cut through it all and separate fact from fiction?

I just happen to have joined an institution with one of the larger Green office/classrooms buildings in the U.S. The University of Texas Health Science Center – Houston School of Nursing (SON) building in the Texas Medical Center is a U.S. Green Building Council Gold Level LEED award winner. The SON has been in operation for about five years. It's easy enough to measure how well this Green Building is performing. This should shed some light on which features are good, which are bad, and which didn't make a whole lot of difference.

Background on the School of Nursing Building (SON)

In 2000, a team of dedicated professionals set out to build a facility that was unlike any other. It was to be an example of how to do it right. An informational booklet states the project team's approach:

> The designers were advocates of a new pragmatism. What a building can do matters as much as what it looks like. Buildings are perhaps best described as instruments or devices whose function is to instill in their occupants an ethos of engaged propinquity in settings that bring the convenience and intensity of the artificial environment into intimate proximity with the amenities associated with the natural surroundings.

School of Nursing – looking southeast

School of Nursing – looking southwest

The School of Nursing reached substantial completion in 2004. A list of SON awards includes:

- 2009 LEED Gold Award. The first building in the University of Texas System to achieve a Gold Level LEED Award
- 2006 Honor Award, Texas Society of Architects
- 2006 Top Ten Award, Sustainable Architecture, AIA National Committee on the Environment
- 2006 Regional Award, Association of Energy Engineers
- 2005 Honor Award, Architecture, AIA Houston
- 2005 Honor Award, Sustainable Architecture, AIA Houston
- 2005 Design Share International Award for Innovative Schools
- 2004 Honor Award for Excellence in Sustainable Design, AIA Kansas City COTE (Committee on the Environment)
- 2004 Honor Award for Excellence in Architecture, AIA Kansas City
- 2004 Honor Award, AIA Kansas
- 2004 Honor Award, AIA San Antonio
- 2004 Merit Award, AIA Central States.

The SON has eight stories and contains 195,160 gross square feet of office, classroom, and student community center space. It includes the following:

- exterior design addresses five facades (the roof is not just a roof)
- daylighting from three rooftop atria and sidewall fenestration delivering light throughout the interior. Generous use of interior glass allows for ample transfer light
- underfloor air system with manually adjustable floor outlets
- demountable partitions for future reconfigurations of interior space
- limited hot water in restrooms. Men's restrooms have waterless urinals
- Green roofs (small sections on north and south)
- structural steel frames on roof to accept future solar panels
- storage tanks, at grade level, collect rainwater for distribution to the wastewater system (flushing water closets) and landscape sprinkling system
- exit stairwells are exterior, open air spaces
- west elevation, which receives intense afternoon sunlight, is the location for unoccupied spaces (e.g., mechanical rooms). West windows were minimized to reduce summer heat gain
- operable windows
- grade-level labyrinth
- architectural "sails" on the east façade to shade glass and bounce sunlight deeper into the building's interior
- building materials contain high amounts of recycled content. Brick is from a 19th century warehouse in Texas, wood siding is from sinker cypress logs, aluminum panels have 92 percent recycled content, structural steel specified to have more than 80 percent recycled content, and concrete contained 48 percent fly ash

- seventy-five percent of the building's construction waste was recycled or salvaged – including waste from the deconstruction of the building that had previously been on the site
- wood products from certified lumber sources
- two-year contract for Green source electricity.

The Comparator

Okay. Several years of performance data has been collected. Now we need a credible comparison. What luck! An unusually well-suited comparator is sitting right next door. In 2000, the University of Texas MD Anderson Cancer Center built a new Faculty Center (FC) on the same general site. The FC is located 400 feet to the east of the SON. The FC is a traditionally constructed, 329,591 sq. ft., Energy Star Award recipient building. The FC was built in the same construction market and university system, experiences the same environmental conditions, and is supplied chilled water and steam from the same central plant (TECO). Factors necessary to translate a comparison project from one location/system/environment to another are not at play with these two buildings.

What Can We Measure?

It's not practical to identify the individual cost/performance of each Green feature in the SON building. We can, however, measure and look into aggregate systems, costs, and results. In one case, the rainwater collection system, individual performance data was available.

1. TOTAL PROJECT COST

The construction cost for the SON was $41,074,362 or $210/sq. ft. The construction cost for the FC, escalated to 2004, was $146/sq. ft. A raw comparison indicates the SON was 44 percent, per sq. ft., higher than the FC. Discounting for some economy of scale for the larger FC, let's say the delta is probably closer to 40 percent.

Was the premium paid exactly 40 percent? Probably not. Even so, while no time travel to compare costs is perfect, and no two buildings are ever completely alike, we can conclude that the calculation puts us in the right ballpark.

2. ENERGY USE

Energy use was recorded for a fiscal year (FY) that runs from September 1 through August 31. In FY 2009, SON total energy consumption was 109.1 MBTU/sq. ft. For the same FY, FC

energy consumption was 116.5 MBTU/sq. ft. The SON used 7 percent less energy than the FC. The monetary value of the savings was $17,328.

3. OPERATING COST

Excluding utilities, SON operating cost for FY 2009 = $1.36/sq. ft. Operating cost for a comparable UTHSC-H building = $1.27 sq. ft. The SON has a 7 percent higher operating cost.

4. HEALTHY BUILDING

In February 2010 the following variables were measured in both FC and SON: dry bulb temperature, relative humidity, carbon monoxide, carbon dioxide, inhalable particulates, and total volatile organic compounds. Dry bulb temperature ran slightly higher in the SON (about 3 degrees). Carbon dioxide ran slightly lower in SON (in the 400s rather than 500s).

There was no appreciable difference in the rest of the variables.

5. RAINWATER COLLECTION SYSTEM

The rainwater system collects/distributes approximately 1.5 million gallons of rainwater per year. The savings, by not using City of Houston water for the same purposes, is $12,500.

Discussion

TOTAL PROJECT COST

Whoa Nelly! What happened to the oft-repeated assumption that a Green building only costs about 5 percent more than a traditional building? Factors involved:

Expensive Materials: Some materials used on the project, such as certified lumber, recycled brick from San Antonio, demountable partitions throughout, and sinker cypress lumber came at a high price.

Pioneering Design: Going boldly, where no one has gone before. Some systems were the first of their kind in the area, and suffered from a lack of contractor experience. For example, the underfloor HVAC system was not workable as initially designed. There were extensive efforts to seal the underfloor plenums so they would hold a workable static pressure. The supply fan selection and location had to be baffled and acoustically treated to reach reasonable sound levels.

Special Features: Some features in the SON would not be present in a traditional building. Examples include a) dormered roof designed for future solar, b) sails on the east side of building, c) 4,000 sq. ft. standalone service building, d) labyrinth, e) LEED certification, f) restrictive environmental construction specification, and g) rainwater collection system.

Constructability: The building was constructed at a time when experience with Green design features (e.g., underfloor

HVAC, rain screen envelope) was in short supply in Houston. It was not easy for the General Contractor to find subcontractors to take the job – so bid prices were high. The contractor also dealt with a lack of off-site Green support services. High content fly ash concrete had to be worked out as a special item. Construction waste recycling was an on-site task of the project crew. Experience with Green materials/Green construction processes/Green support services are not uniformly distributed across the U.S., and must be kept in mind when estimating cost.

The SON building was in the lead position for the development of Green buildings in the Houston area. The lead position is an expensive proposition.

Rating: Bad

ENERGY USE

The investment in Green design yielded not much more than what you find with an efficient, modern building. This is not surprising. Professional staffs in higher education have been laboring over squeezing the last drops of efficiency and durability out of buildings ever since the Oil Embargo of 1979. Educational facilities professionals learn from each project and deliver state-of-the-art buildings that compare favorably with the best in North America. Higher Ed is not fertile ground for substantial improvements in building design.

Rating: Neutral

OPERATING COST

FEATURE	GOOD	BAD	NEUTRAL
Project Cost		X	
Energy Use			X
Operating Cost			X
Healthy Building			
Rainwater Collection			
Empty Solar Racks		X	
Floor Plan	X		
Operable Window			X
Demountable Panels			
Unfinished Surfaces			
Green Roofs			X

The 2009 non-utility operating cost for the School of Nursing building was $1.36 per sq. ft., which was 7 percent higher than the $1.27 per sq. ft. reported for the UTHSC-H building next door – the School of Public Health Building. The FC is not used as the comparator here because services, such as housekeeping, can only be compared under the same UTHSC-H contract for type and frequency of services.

Rating: Neutral

HEALTHY BUILDING

It is not easy to put a subject like 'healthy environment" on a comparison list. Many aspects of it are subjective. The building's designers defined "healthy" as indoor air quality, daylighting, and comfort.

Daylighting is a prominent Green feature in the SON and is enjoyed by occupants who feel they benefit from natural light in the workplace. A drawback is having prime interior space, over 8,000 sq. ft., dedicated to skylights rather than finished space. Testing dry bulb temperature, relative humidity, carbon monoxide, carbon dioxide, inhalable particulates, and total volatile organic compounds revealed there is no appreciable difference in these values for the two buildings.

Rating: Neutral

RAINWATER SYSTEM

The system collects approximately 1.5 million gallons of rainwater per year. The avoided cost to the university is $12,500. With an interest in duplicating the system in another facility, it was priced out in 2009 at $1.5 million. At this high cost, the design was not usable as a template for future projects.

After six years, the five storage tanks are rusting out. The cost to place a liner in one tank is about $19,000. The system is performing well but is way too expensive. Tank volumes will be closely monitored, with an eye to reducing the number of tanks in operation to lower the annual operating cost.

Rating: Bad

There are items that don't lend themselves to field measurement, but are worth discussing

EMPTY SOLAR RACKS

Empty solar racks on the roof of SON are visual testimony to the high cost and poor economics of a photovoltaic solar system in this location. A third party has proposed placing a photovoltaic system on the building. The system was designed to have a 135.3 kW solar panel array design and cost $1 million. Without substantially subsidizing the system, there was no economic payback within the expected useful life of the solar panels (30 years).

An alternative to producing Green electricity with on-site PVs is to purchase Green power off the grid. Let's compare. The solar system mentioned above was also offered under third-party ownership. The proposal offered the installed system for a commitment to purchase its output at 14 cents/kWh. Alternatively, a 100 percent wind-generated Green power offer was available off the grid at 11.5 cents/kWh. Wind turbine farms are located in west Texas, and make the Texas ERCOT grid one of the Greenest in the nation. Selecting the better of the two options, a contract was signed to purchase Green power off the grid.

Rating: Bad

FLOOR PLAN

The building's floor plan placed as many unoccupied spaces as possible along the hot (prevailing summer condition) west wall, and highly utilized spaces along the cooler east side with a view to Fay Park. A low percentage of fenestration on the west wall, to reduce solar heat gain, is not a drawback for most of the spaces located on that exposure.

Rating: Good

OPERABLE WINDOWS

Some occupants open the windows and enjoy the fresh air on mild days. There is no general use of them as a managed feature – such as turning off the chilled water and opening the windows as you might do in your residence. So, the extra cost to have them installed is only balanced by unmanaged use by some occupants.

Rating: Neutral

DEMOUNTABLE PARTITIONS

If a facility will have a high churn rate on space layouts, then demountable partitions would be a good investment. If, after a floor plan is set, it essentially never changes, then they are not such a good investment. The latter is the case with the SON building.

Rating: Bad

UNFINISHED SURFACES

While a building design that minimizes traditional finishes can draw criticism from some occupants, it is an effective device used in the SON building. It reduced the volume of source materials (e.g., there is no finish material on stairs other than concrete) and long-term costs (if there is nothing there to start with, there are no costs to maintain or replace it).

Rating: Good

GREEN ROOFS

Occupants on the Green roof level like them as amenities. The dirt improves the roof's R value, but will require eventual excavation work to find and repair leaks. Aspects of a green roof that are not measurable are reducing the "heat island" affect in the Texas Medical Center and holding back some rainwater from flowing into Brays Bayou.

Rating: Neutral

Getting back to the original question

Which features are good, which are bad, and which did not make a whole lot of difference for this particular Green building? Ratings are assigned on the basis of the SON results, as measured in 2010 vs. the traditionally constructed Comparator.

IF going with everything labeled Green doesn't always work out so well, where are the guardrails that will keep a project on the right road?

INSTITUTIONAL POLICY

What do you do when you are faced with a choice between traditional construction and Green measures? You can be questioned from either direction: Why isn't the new building LEED certified? and Why is the new building LEED certified? The place to be standing is on the firm ground of an institutional or system policy. An excerpt from the University of Texas System Policy on Sustainability Practices (put into place *after* the SON was built) states:

HIGH PERFORMANCE BUILDINGS

Each institution will strive to achieve a high-performance building comparable to a U.S. Green Building Council Leadership in Energy & Environment ("LEED®") Certified rating or higher whenever possible, excluding laboratory and acute care and patient care facilities, within the constraints of program needs and budget parameters. System recognizes and commends the early leadership and accomplishments of LEED® as a Green building certification program; however, that certification currently comes with a significant cost in documentation. Therefore, while System strives for a high-performance building standard comparable to LEED® for new major capital projects, money for certification documentation is better spent obtaining more energy-efficient building systems.

CONCLUSIONS

1. The SON is a noteworthy building that has received many well-deserved awards, is a source of pride for the university, and provides an enjoyable environment for occupants and visitors.
2. However, if the door is too wide open to all things Green, a project can become very expensive and end up diminishing the required end result – new square footage.
3. Local/regional construction/design markets are not uniformly mature in supporting Green projects. If a project is in a market that has not produced several Green buildings, you will pay a premium for being the first.
4. Public interests ought to follow good design practice – not be in the expensive "bleeding edge" position.
5. Being Green does not automatically mean low operating costs. The LEED Gold Award SON building's energy and operating costs are about the same as any modern, higher ed building.
6. Green building standards will have the most impact in sectors that have not previously cared much about long-term costs. Higher Ed campuses are acutely aware of long-term costs, and have designed and built efficient, durable buildings.
7. Analysis of this project confirms the appropriateness of the University of Texas Sustainability Policy.

Rich McDermott is vice president, facilities, at the University of Texas Health Science Center – Houston. He can be reached at *richard.l.mcdermott@uth.tmc.edu*.