“It’s one thing to say you’re committed to downtown revitalization and urban renewal, to historic preservation and environmentally friendly building practices. But when you see a company like Christman, a major downtown anchor for the last 80 years, put its money, skills and passion where its mouth is and come up with something this incredible right here in downtown Lansing, you know it will inspire other businesses to move or remain here.”

LANSDING MAYOR VIRG BERNERO
Adaptive reuse is ideal for older cities that have a large stock of historic buildings. But how much does it cost to design, renovate and operate a repurposed building compared to a conventionally constructed building? Construction management and real estate development firm The Christman Company discovered that for its new headquarters in Lansing, Mich., it doesn’t cost more. Reaching energy use targets, however, has required ongoing commissioning to fine-tune the building.

The Christman Building is the world’s first triple Platinum LEED project, recently adding LEED-Existing Buildings (2010) to its Core and Shell and Commercial Interiors certifications (2008). After the initial construction project, the building was expected to operate at peak energy efficiency, but this turned out not to be the case for a variety of reasons (see Lessons Learned, Page 26).

As has been well publicized, the building’s higher than expected energy consumption was not a unique result for LEED certified buildings and resulted in the USGBC forming the Building Performance Partnership to help address this important issue.

This 1928 landmark building, on the National Register of Historic Places, is located in the heart of Lansing, Mich., near the state capitol. Its new lease on life was accomplished in a 2007 major renovation.

The downtown building and brownfield site provided an excellent candidate for a milestone green and historic preservation project. The design reused 92% of existing walls, roof and floors, and most of the company’s former office furnishings.

Extensive recycling diverted 77% of construction debris from the landfill. Recycled and regionally manufactured materials, and low emission sealants, paints, carpets, and furniture were used extensively. The interior provides outdoor views to 90% of occupants. Workspaces are designed for flexibility, adaptability, collaboration and teamwork.

Reusing this historic building tapped the inherent embodied energy and resources, avoided suburban sprawl and contributed to downtown revitalization. Its location uses existing public transportation...
and parking facilities. Showers and locker rooms encourage walking and bicycling to work. The white roof and directed exterior lighting reduce heat island effects and light pollution.

Energy use is reduced with task lighting, occupancy sensors, programmed timers in common areas, daylighting for 92% of occupants, high efficiency windows and ENERGY STAR office equipment and appliances. High efficiency HVAC systems provide individually controlled comfort conditions. The underfloor air distribution system maximizes efficient, healthy ventilation.

Low flow fixtures including dual flush toilets, 0.5 gpf urinals, 0.5 gpm automatic faucets and 1.5 gpm showers reduce water consumption by 45% from the LEED-EB calculated baseline design. Energy modeling projected an ENERGY STAR rating of 75.

For the core and shell project, the costs associated with achieving green goals represented 1.3% of the total budget. Two-thirds of those costs were related to the LEED certification process. For the commercial interior project, the costs associated with achieving green goals represented 0.7% of the total budget. Of those costs, 95% were related to the LEED certification process.

**Pursuing LEED-EB**

The Christman Company executive team committed in January 2009 to expand green housekeeping and recycling programs into a comprehensive company-wide green operations program, using LEED-EB as a guide. The company also decided to have its headquarters building certified LEED-EB.

Given that the Christman Building had achieved the first double-platinum LEED certification, the bar was already set very high. Going into the LEED-EB process, the team knew that improvements could be made in materials purchasing, energy efficiency, carbon footprint management, and documentation of all sustainable building activities.

The first step in improving the energy performance was to benchmark the building using the EPA ENERGY STAR Portfolio Manager program. After the actual utility data from the first year of operation was entered, the building received an ENERGY STAR rating of 39, revealing substantial room for improvement.

In hindsight, the primary causes of this situation included insufficient time in a construction schedule driven by an aggressive completion date to meet historic tax credit requirements (see Historic
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An extensive recommissioning process was developed to verify and fine-tune the operation of all energy-using systems. The primary recommissioning team was comprised of the HVAC systems design engineer, a temperature controls technician, the controls contractor and the sustainable programs manager from The Christman Company.

Unfortunately, the controls technician assigned to the project did not have the required skills and experience to satisfactorily complete the installation in the time allocated (despite working for a highly qualified and reputable firm), and no systems level commissioning was conducted.
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sequences included additional reset schedules, a morning warm-up program, and scheduling equipment and building load response sequences of operations. Extensive trend logging helped to facilitate and confirm the recommissioning efforts.

The server room cooling unit was identified as being oversized due to recent IT equipment changes. Accordingly, the 10 ton unit was replaced with two 1.5 ton units. The IT department purchased a network management program that enabled central control of computers and monitors, allowing this equipment to be put into a verified sleep mode when not in use.

The recommissioning process also discovered that some of the hot water piping in the underfloor air either out of calibration or not operating properly, and fire dampers that were closed in many locations.

All controls were calibrated, their operation verified, and thorough component and system level functional checks were completed. Fine-tuning of schedules and operation

Left. The design takes advantage of large perimeter windows to provide daylighting to 92% of occupied spaces building-wide and outside views to 90% of the occupants in the Christman headquarters.

**Recommissioning and Energy Use Improvements**

The formal recommissioning process was used to ensure that all components and the entire HVAC system were operating per the design. The process identified many sensors and controls that were either out of calibration or not operating properly, and fire dampers that were closed in many locations.

All controls were calibrated, their operation verified, and thorough component and system level functional checks were completed. Fine-tuning of schedules and operation

**HVAC.** The HVAC systems were designed, and the equipment was selected, to minimize energy use while providing individually controlled comfort conditions. A detailed life-cycle cost analysis determined that an underfloor air distribution system using VAV air handlers was the best option since it is more energy efficient than a conventional ducted system. The first cost was neutral due to the elimination of most of the ductwork required by a conventional overhead VAV distribution system.

Two multistage hot water boilers adapt to seasonal heating loads as does the staged air-cooled chiller. All cooling equipment uses refrigerants that cause minimal damage to the environment.

**Envelope.** The white roof and 6 in. of added insulation reduce the urban heat island effect and reduce energy use. The building’s original front façade window frames have been restored and fitted with double-glazed glass to increase their energy efficiency. The building’s side and rear exterior windows have been replaced with efficient aluminum windows. Due to the historic nature of the building, no insulation was added to the exterior walls.

**Daylighting.** The design took advantage of large perimeter windows to provide daylighting to 92% of the building’s occupied spaces and outside views to 90% of the occupants in the Christman headquarters.

**Lighting/Controls.** Additional background lighting is provided by high efficiency fixtures and T-5 fluorescent lamps with a high color rendering index (CRI). All workstations have individually controlled multilevel task lighting. Use is controlled by occupancy sensors in private offices and stairways, and programmed control panels in common spaces.

**Controls.** The web-based building management system (BMS) has several thousand control points that are used to operate the building systems for maximum efficiency and comfort. Energy use is metered at the building and tenant levels to encourage conservation.

**Plug Loads.** All appliances and office equipment, including copiers, fax machines and computers are ENERGY STAR rated. IT equipment is controlled by network power management software.

**Commissioning.** Recommissioning and ongoing commissioning of all HVAC, lighting and domestic water systems ensure that all systems operate as designed and are continually fine-tuned.
distribution plenum space was not insulated, and this was corrected. An infrared scan of the building envelope identified substantial air leakage around the sashes of the restored 1928 windows on the west elevation. All of these windows were subsequently sealed, resulting in reduced infiltration and improved comfort conditions.

The lighting systems were investigated and unnecessary night lighting was eliminated. Lighting control schedules were refined to match actual occupancy. Occupancy sensors in private offices were reset to turn lights off after eight minutes, and additional occupancy sensors were installed in seven conference rooms and offices. The lights and exhaust fan in the elevators were programmed to turn off when the elevator is unoccupied.
• Implementing enthalpy economizer control;
• Implementing unoccupied return fan speed control;
• Resetting supply duct static pressure setpoint to match demand at VAV boxes;
• Resetting chilled water differential pressure setpoint to match demand at chilled water coils;
• Controlling the bypass valve to maintain a setpoint minimum differential pressure across the chiller;
• Refining hot water flow control sequence of operation;
• Implementing unoccupied reheat valve control on VAV terminal units;
• Implementing unoccupied setback control on VAV terminal units; and
• Implementing unoccupied setback control for the perimeter floor zones.

An ongoing commissioning plan was also developed to use the trend logs and actual observation to formally check the operation of all energy consuming systems several times per year. On a daily basis, the facility technician and facility

**HISTORIC AND PUBLIC/PRIVATE PARTNERSHIP TAX CREDIT**

The project was conceived and developed by Christman’s real estate group as a public/private partnership, incorporating:

- $672,500 in state of Michigan Brownfield single-business tax credits;
- $2 million in federal historic tax credits;
- $500,000 in state historic tax credits;
- $1.2 million ($100,000/year for 12 years) in property tax relief through establishment of a Federal Obsolete Property Rehabilitation Act (OPRA) district; and
- $8.5 million in below-market-rate loans through federal New Markets Tax Credits.

**LESSONS LEARNED**

Allow added time in construction schedules for proper controls installation, fine-tuning and thorough commissioning. These activities typically occur at the end of the project and are often not given enough time to be done properly.

Verify during the selection process that the individual controls technician assigned to the project has the required skills and experience to complete the installation and that sufficient time is allocated in the contract.

Verify that comprehensive commissioning is completed at the component equipment level and, more importantly, at the systems level.

Plan on dedicating time to fine-tune systems operation to actual occupancy and climatic conditions. System operating parameters, out of necessity, are theoretical at the time of design and installation and need to be adapted to actual conditions for peak energy efficiency to be achieved.

Within the second year of operation, begin ongoing commissioning and conduct an energy audit. Engage operations staff in this effort to maximize additional energy saving opportunities.

**Environmentally benign products, such as citrus strippers and low-VOC coatings, were used to restore historic finishes, such as the walnut paneling in the executive offices on the first floor. All plaster walls were also restored.**

**Ongoing Commissioning**

Approximately six months after the recommissioning effort was completed, an ongoing commissioning process was initiated. As a first step in this ongoing commissioning process, an engineering firm that specializes in commissioning was retained to remotely monitor the building management system (BMS) over an approximate one-month period in October/November 2009.

Using the remote access to the BMS and the extensive trend logs previously developed, the company confirmed that the systems appear to be well-conceived, programmed with energy conservation in mind, and operating as intended. Other areas that merited additional attention were identified:

- Controlling economizer dampers for discharge air temperature;
- Implementing enthalpy economizer control;
- Implementing unoccupied return fan speed control;
- Resetting supply duct static pressure setpoint to match demand at VAV boxes;
- Resetting chilled water differential pressure setpoint to match demand at chilled water coils;
- Controlling the bypass valve to maintain a setpoint minimum differential pressure across the chiller;
- Refining hot water flow control sequence of operation;
- Implementing unoccupied reheat valve control on VAV terminal units;
- Implementing unoccupied setback control on VAV terminal units; and
- Implementing unoccupied setback control for the perimeter floor zones.

An ongoing commissioning plan was also developed to use the trend logs and actual observation to formally check the operation of all energy consuming systems several times per year. On a daily basis, the facility technician and facility

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A detailed occupant survey that asked questions related to occupant comfort, indoor air quality, acoustics and housekeeping identified areas of concern and satisfaction. The most common complaint related to the office environment acoustics while indoor air quality received the highest rating. A response plan was implemented to improve comfort, IAQ, maintenance, and housekeeping issues as identified.

**Indoor Air Quality**

An indoor air quality (IAQ) management program was developed and implemented based on the EPA’s Indoor Air Quality Building Education and Assessment Model (I-BEAM). The program includes thorough periodic inspections of all HVAC and building components to identify and, if necessary, correct any issues that could impact the building IAQ.

The airflow monitoring stations on the air-handling units are calibrated three times a year to ensure that

**Water Conservation**

Efficient plumbing fixtures help reduce water use by 45% compared to the LEED-EB baseline.

**Recycled Materials**

Building tenants purchase office supplies, paper, IT equipment and other consumable and durable goods based on sustainable criteria. White paper, mixed paper, cardboard, glass, plastic, soda cans and bottles, printer cartridges, batteries, lamps and wood are recycled. During the performance period, 73% of the building’s 59,956 pounds of waste was diverted from landfills for recycling or reuse.

**Daylighting**

Large perimeter windows provide daylighting to 92% of occupied spaces and outside views to 90% of the occupants.

**Individual Controls**

Multi-level task lighting at workstations, thermal control via UFAD floor registers and/or thermostats

**Other Major Sustainable Features:**

A major recommissioning effort resulted in substantial energy, environmental and cost savings.

Renewable energy credits offset 100% of the building’s electrical use.

A lamp purchasing plan reduced the mercury in the lamps used in the building.

An indoor air quality (IAQ) management program was developed and implemented based on the EPA’s Indoor Air Quality Building Education and Assessment Model (I-BEAM). The ventilation rates for the building are maintained at 30% above the minimum required by ASHRAE Standard 62.1-2007.
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Carbon Offset

Renewable energy certificates for clean wind energy were purchased to offset 100% of the electricity used for the entire Christman Building for two years (1,121,200 kWh). The cost of the renewable energy certificates was $0.00193/kWh. This will reduce CO2 emissions by 569 MtCO2e/yr, which is equivalent to planting 5,162 trees or reducing driving by 1,267,137 miles.

In addition, 100% of the two-year natural gas use of 48,792 ccf/yr has been offset with American Carbon Registry verified emission reductions (VERs), at a cost of $5.74/ MtCO2e, resulting in an additional carbon offset of 291 MtCO2e /yr.

Costs and Payback

Based on actual utility bills and the Portfolio Manager Program, the energy saving measures implemented during the first LEED-EB performance period saved 24,640 ccf of natural gas/yr and 354,780 kWh/yr. The building’s energy use index (EUI) was reduced from 122 kBtu/ft² · yr to 65.9 kBtu/ft² · yr.

These efforts have resulted in utility cost savings of $49,919 per year, and a CO2 pollution reduction of 380 MtCO2e/yr. Actual expenditures for these improvements were $14,224.

During this first LEED-EB performance period, some consultants assisted with developing standard operating procedures and policies. A total of $22,280 in hard costs were expended to implement the LEED-EB program, including the commissioning and energy saving measures. Internal staff costs amounted to $42,000 during the first one-year performance period. The calculated projected cost savings are expected to be in the range of $62,000 per year, resulting in a simple payback of 1.04 years.

Conclusion

Even though a building may be designed with energy-efficient systems and achieves two LEED Platinum certifications, that is no guarantee that it will actually operate at maximum efficiency. Careful formal recommissioning, as a part of a LEED-EB effort, and continuous operational fine-tuning has resulted in The Christman Building’s ENERGY STAR rating increasing from 39 to 81 in one year, exceeding the original design goal of a 75 ENERGY STAR rating.

Ongoing benchmarking using the ENERGY STAR Portfolio Manager and/or the USGBC Building Performance Partnership programs helps to ensure continued peak energy performance.
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