

Building-Envelope Studies Assist LEED Design

— Craig A. Shutt

A range of attributes must come together for a building to be certified under the Leadership in Energy & Environmental (LEED) standards of the U.S. Green Building Council. Thermal analyses and insulated precast concrete wall panels can help ensure that the most efficient design and construction methods are used.

First Jacksonville Project

An example of the impact building-envelope studies and the use of precast concrete can have on the LEED-certification process can be seen in the new Social Sciences Building at the University of North Florida (UNF) in Jacksonville, Fla. The precast concrete insulated sandwich wall panels were instrumental in the building attaining the city's first LEED certification. School administrators were so pleased with the outcome that they intend to follow similar construction methods and specifications on future buildings to meet LEED standards.

"We put some more money into the design, and that's sort of consistent with our environment," says John A. Delaney, UNF president. The school is set in a nature preserve, and administrators wanted to not only create an environmentally friendly project but ensure it blended with its "green" surroundings.

In fact, the university did not have to increase its budget significantly to create a green building, notes Mark A. Gelfo, a LEED-certified principal with LEED consultant TLC Engineering for Architecture in Jacksonville. "The premium hard and soft costs for achieving LEED certification were approximately 1% of the construction cost," he estimates. "There were a lot of UNF standards that already were green or sustainable, which helped contribute to the point total."



Jacksonville, Fla., university uses thin-brick systems and thermal analysis along with precast concrete insulated wall panels to achieve certification

The \$13.3-million, three-story project features 63,000 square feet of space, housing offices for faculty, staff and administration, as well as five conference rooms, lounges, and study areas. The centerpiece of the building is five regular and two theater-style classrooms and three teaching laboratories, all equipped with “smart” technology and wireless-communication systems.

The building features a variety of environmentally friendly aspects, including waterless urinals, an emphasis on natural light and energy-efficient heating and mechanical systems. It uses recycled water for irrigation and other needs while providing high energy efficiency.

Initially, designers planned to construct the building using a system of brick on steel studs structural system. But after an in-depth series of studies conducted by Dow Building Systems in conjunction with Gate Precast Co. in Jacksonville, designers were convinced to convert the exterior wall panels to a precast

concrete sandwich wall-panel system featuring the Thermomass Building Insulation System.

“The UNF building is truly an achievement in sustainable construction using precast sandwich wall panels,” says Brad Nessel, regional sales manager for Thermomass.

Withstanding Florida Extremes

The key concern was designing an envelope with a material that could withstand the extreme Florida temperatures and humidity. The campus previously had dealt with a mold and mildew issue with an existing building, so administrators were sensitive to those concerns. The precast system could reduce the risk and protect against vapor drive while also providing high thermal performance and interior comfort. The brick and steel-stud structure initially proposed featured highly conductive steel studs and brick ties, which reduced the R-value of the assembly under ASHRAE 90.1 standards while increasing the likelihood for moisture migration and infiltration.

“Even a slight thermal bridge through the insulation can reduce the overall thermal performance of a wall assembly tremendously,” Nessel notes. “That can be critical with brick and steel-stud assemblies, which are thermally conductive, bridging the insulation and reducing the assembly’s effective R-value.”

In fact, an Isothermal Analysis determined the effective R-value of the wall assembly after all thermal bridges were taken into account, and found the original system was much less effective than expected. “The steady-state value of R-8.38 for the proposed brick and steel-stud structure was significantly less than the assumed material R-value of R-12.29—a reduction of approximately 30%,” Nessel explains. The assumed R-value would have been used when sizing the mechanical equipment for the building and establishing code compliance.

The insulated precast panels provided no thermal short circuits, resulting in a constant, even, post-construction temperature. The panels also created a continuous vapor retarder, producing no potential locations for mold and mildew growth. “By designing a wall with nonconductive composite wall ties, edge-to-edge insulation, and no cavity, we removed thermal short circuits and convection looping,” Nessel explains.



Fact Sheet

Project: Social Sciences Building

Type: Classroom and offices

Location: Jacksonville, Fla.

Designer: Smith-McCrory, Jacksonville

LEED Consultant: TLC Engineering for Architecture, Orlando, Fla.

Construction Manager: Elkins Constructors Inc., Jacksonville

Owner: University of North Florida, Jacksonville

Precaster: Gate Precast Co., Monroeville, Ala.

Project Size: 63,000 square feet

Precast Components: 39,651 square feet of insulated precast concrete panels

Project Cost: \$13.3 million

The capabilities of the precast system were verified with thermal-imaging tools. This technology uses infrared rays to detect the amount of heat energy in a location. By collecting a thermal array, designers can determine if energy leaks are occurring and how much heat the walls are allowing to escape (or penetrate, if the interior is being imaged). This technology helps designers and owners ensure that they are using the best system possible for their project.

The insulated precast wall panels consisted of 2 inches of Styrofoam brand extruded polystyrene (XPS) insulation sandwiched between two wythes of concrete. The total thickness of the panels ranged from 10 to 12 inches, depending on the location and application, explains Jim Lewis, director of architectural systems for Gate Precast Co. in Jacksonville, Fla. Calculations showed that the high-mass system would provide a performance rating of R-24, significantly higher than the other system.

Lessons Learned

The design team achieved a significant accomplishment in certifying Jacksonville's first LEED project. But it learned several key lessons along the way:

1. Start Early. LEED certification did not become a goal until the program was developed, the site selected and the building form determined. Earlier planning could have allowed the building geometry and fenestration to further increase energy efficiency and achieve daylight and view credits.

2. Use an Integrated Team Approach. Include the entire design, construction and owner team from the beginning. Having all members on board, especially the contractor, contributed greatly to the success of the project.

3. Keep Improving Energy Efficiency. The building envelope, lighting systems and HVAC systems could have been designed with even greater energy efficiency if first costs could have been increased. The long-term costs would have offset that cost, and that can be a strong incentive for a building that is owned and operated by the client.

Brick Embedded In Panels

Most of the panels were finished with thin brick embedded in the panel face at Gate Precast's manufacturing facility in Monroeville, Ala. Other areas received a light sandblast finish to provide contrast with the brick. Some 39,651 square feet of panels were used in the project.

To create the brick façade, Gate Precast Co. used a newly developed formliner grid to hold the thin brick in place during casting. The sheets, which are peeled off after the panels are stripped from the forms, use 100% post-industrial recycled content, explains Lewis. "It's more costly, but it's a great product for this application and helps with several key LEED points."

Gelfo praised the in-depth analysis provided for the precast panels. "Gate Precast provided the best documentation for the LEED analysis of all the material suppliers," he says. "The entire precast wall system contributed greatly to the building's overall energy performance, along with HVAC and lighting." The result of this combination of systems was that the project is performing 34% above the minimum ASHRAE 90.1 requirement, he notes.

Early in the design process, a green-building design charrette was held with the entire design and construction team to determine the "green goals" for the project and which LEED credits would be pursued. The goals included minimizing energy and water use, maximizing environmental quality and—most importantly—staying within budget.

'Credit Guardians' Named

Each member of the team was named a "Credit Guardian" for specific credits, including even ones that the team decided not to attempt to gain. The guardians reviewed, investigated and documented each credit, to ensure its requirements were being met (or could not be met) as the project progressed. The high-performance precast concrete insulated wall panels helped meet a number of the LEED criteria, including:

Energy & Atmosphere

Optimize Energy Performance:

The precast wall system maximized the thermal-mass effect of concrete, reducing the heating and cooling loads and providing an R-value (R-24) greater than what could be expected by the material alone or by what the code required.

Materials & Resources

Building Reuse:

The wall panels will aid in extending the life cycle of the facility, reduce waste and environmental impacts and conserve resources. "The Social Sciences building was built to be a 100-year-plus facility, and the panels will help ensure it meets that goal," says Lewis.

Construction Waste Management:

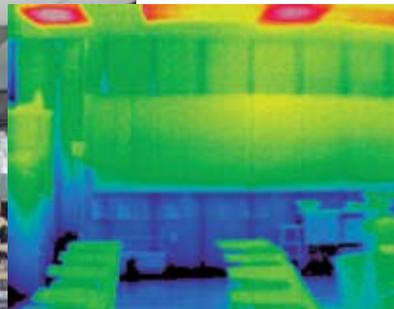
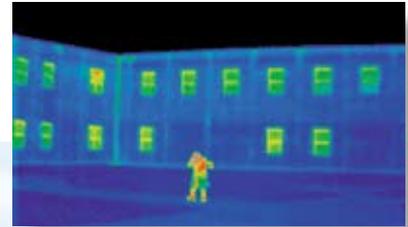
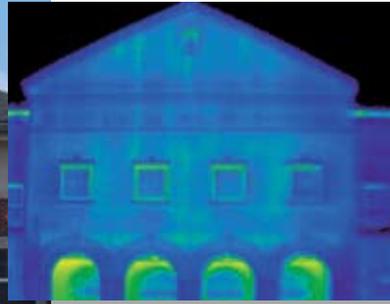
The system's individual components all are 100% recyclable. Scrap materials were taken to a polystyrene recycling center and recycled into other products, diverting them from landfills. In addition, Gate diverted construction waste during production, crushing the 143 square feet of waste concrete in the plant and turning it into roadfill.

Recycled Content:

To reduce the impact from processing new virgin materials, the Styrofoam-brand XPS insulation contained up to 40% post-industrial recycled content. The reinforcing steel, wire mesh, steel connectors and white cement used in casting the panels also featured recycled content. Gray cement, which was used in the backup material for the panels, included silica fume and fly ash. (The additives could not be used with the white-cement mix, as they can alter the final color of the panels, Lewis says.)

Local/Regional Materials:

Manufacturing the precast panels at the local Gate plant reduced the environmental impacts of transportation. The thin brick also aided this reduction. As the bricks use less material, more can be packed on a delivery, and they weigh less. Approximately 65% of all materials used in the building were manufactured within 500 miles of the site, Gelfo says.



Thermal-imaging studies use infrared rays to detect the amount of heat energy in a location. These “after” images with precast concrete panels in place on a high-school project, show the low-heat blues and greens that are desired rather than the red/orange “hot spots” that indicate energy loss.

Indoor Environmental Air Quality

Construction IAQ Management Plan During Construction:

Installation methods for the precast wall panels were designed to help alleviate air-quality problems encountered during the construction process and to help sustain the comfort and well-being of construction workers. Since the panels were cast and cured off-site, they contributed no dust or airborne contaminants from drying or curing of compounds during the construction phase.

Thermal Comfort:

The USGBC encourages the construction industry to provide a thermally comfortable environment that supports productivity and well-being of building occupants. The panels effectively manage moisture and maintain a constant, even internal temperature.

Sustainable Sites

Site Development—Protect Or Restore Habitat:

The panels were erected with crawler cranes that were kept within 30 feet of the project, Lewis says, helping to minimize site disturbance and aid with this credit.

Heat Island Effect—Non-roof:

The panels helped raise the building’s albedo, which is the amount of solar radiation the material reflects rather than absorbs. Gate used a high quantity of white cement in its design mix to enhance the albedo of the panels. The result was that 47.39% of the surface area qualified as having a high albedo rating, Lewis says.

“The high-performance precast wall panels provided exceptional performance, and we could confirm that to administrators and designers with independent analysis and our historical results,” Nessel says.

It won’t be the last such project at the university, Delaney says. “We’re going to do the rest of our buildings in this same fashion from now on,” he noted at a news conference. Planned “green” projects include a new student union, a parking-services facility, a housing project, the Brooks College of Health, and the College of Education & Human Services.

“I’m excited that the university is paving the way in Jacksonville with a new learning facility that is environmentally responsible,” he says. “It’s a healthy place for UNF students to learn and faculty and staff to work.” ■