

Wall Panels Aid Sustainability

— Craig A. Shutt

Architectural and structural precast concrete panels help architects achieve a variety of LEED points

As more building owners around the country focus on obtaining LEED certification for their projects, designers are looking for every way to achieve that goal. In many cases, they are finding that precast concrete wall panels, both architectural and structural, contribute



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to a variety of LEED points, including energy efficiency, recycling, local materials and minimized construction waste.

Architects at Booth Hansen in Chicago, Ill., found city officials receptive to the use of structural precast concrete panels when the firm drew up plans for a prototype for the Chicago Park District's new field house. The design will be used to create new facilities on an ongoing basis for a number of parks where existing structures are deteriorated or too small, explains George Halik, principal and project manager. The design will achieve at

least a Silver LEED rating, and potentially Gold.

"The park district required sustainable design and LEED Silver certification as part of the design goals, because that approach will save everything—cost, materials, and efficiency. That's the ultimate goal." Each 18,000 ft² facility includes a gym, two club rooms, a fitness center, lockers, showers, and a central lobby. The prototype facility has also been designed to accommodate a pool in a 12,000 ft² addition at a later date. Two facilities have been scheduled for completion this year.

In their presentation, Halik and John Birazzi, principal and technical director, were asked to show how their approach would use materials efficiently. A key component was their use of structural, insulated precast concrete panels. "We've been using precast concrete panels both as an architectural and structural material for some time, and they work well for a field-house application," says Birazzi. That's especially true where tall spaces are required, such as for pools and gymnasiums. "We can use it quite effectively there."

A prototype for a field-house design to be used by the Chicago Park District in Chicago, Ill., was designed to achieve a Silver and possibly Gold LEED rating, with help from precast concrete insulated sandwich wall panels. The design by Booth Hansen will be used in a variety of Chicago parks.



Fact Sheet

Project: Chicago field-house prototype

Type: Park field house with gymnasium, fitness center, lockers, showers, and lobby

Location: Chicago, Ill.

Designer: Booth Hansen Architecture, Interiors, Planning, Chicago

Engineer: Matrix Structural Engineering, Chicago

Contractor: TBD

Owner: Chicago Park District

Precaster: TBD

Size: 18,000 ft² (plus 12,000 ft² pool addition as option)

Precast Concrete Components: Load-bearing insulated sandwich wall panels

Project Cost: TBD

LEED Rating: Silver, possibly Gold



The Dave Mungenast Lexus dealership in St. Louis, Mo., will be the first LEED-certified Lexus facility in the country and the first LEED-certified dealership in Missouri when it is completed. The project features precast concrete solid spandrel panels on its bowed showroom facade and insulated sandwich wall panels on office and service areas.

Fact Sheet

Project: Dave Mungenast Lexus

Type: Auto dealership

Location: St. Louis, Mo.

Designer: HDA Architects, St. Louis

Engineer: Murphy Co., St. Louis

Contractor: Holland Construction Services, St. Louis

Owner: Dave Mungenast Lexus

Precaster: High Concrete, Paxton, Ill.

Size: 70,000 ft²

Precast Concrete Components: Insulated sandwich wall panels, solid spandrel panels

Project Cost: \$16 million

LEED Rating: Silver

'The technology has now reached the point where insulated precast concrete panels are a tried and tested system.'

LEED Lexus Dealership

Holleran Duitsman Architects (HDA) in St. Louis, Mo., found a receptive audience in a local Lexus dealer who was looking for a marketing edge with environmentally concerned customers. When the new facility for Dave Mungenast Lexus is completed later this year, the \$16 million project is expected to be the first LEED-certified Lexus dealership in the country and the first LEED-certified auto dealership of any kind in the state. The project was designed to achieve Silver LEED certification and includes insulated precast concrete structural panels.

"The precast concrete insulated panels are a key factor in achieving

LEED certification," says Josh Goodman, the project manager, who is a LEED Accredited Professional. The 70,000 ft² project had to include certain design characteristics and materials set by the national Lexus office, but that standard already features precast concrete panels, notes Mark Duitsman, design principal. "We took the product and put a different spin on it," he says.

The panels feature 3 in. of insulation between a 6-in.-thick interior structural wythe and a 3-in.-thick exterior architectural wythe. The facility includes a two-story showroom with a curving facade and mezzanine plus one-story service bays and office sections. Insulated panels were used throughout,

including on the service bays.

"The technicians working on these cars need to be kept comfortable while they work, so their stations need to be heated and cooled, requiring an energy-efficient building," says Duitsman. The bay doors use high-speed controls to reduce infiltration of outside air, while the panels provide a durable interior wall. "The service area needs a wall that can take abuse, and precast concrete provides that," he says. "It creates an interior wall that we just have to paint."

Kettle Foods Gains Gold

Warehouse buildings of all types are evaluating precast concrete wall panels when looking to achieve higher sustainability goals. Kettle Foods in Salem, Ore., an organic potato chip maker, wanted to design a highly sustainable manufacturing plant and warehouse when it built in Beloit, Wis. The 75,000 ft² facility, which opened in September 2007, features precast concrete insulated structural panels. The \$10 million project is the first industrial structure in Wisconsin to achieve Gold LEED certification and the first food-manufacturing facility in

the country to achieve that status.

"Kettle Foods has a workplace philosophy they call 'seasoning with sustainability,'" explains Ellen Skorpinski, mechanical engineer with ACS in Madison, Wis., the design-build firm that delivered the project. "The philosophy is driven by efforts to lower their environmental impact and make the facility a healthier, happier workplace for employees to continue their commitment to hand crafting the best-tasting, all-natural potato chips."

There were a lot of challenges due to manufacturing requirements, she notes. "Most LEED projects are commercial buildings and office buildings, and it is easier to design those as LEED buildings. We had to do everything imaginable to get this to be Gold certified."

One contribution came from precast concrete insulated structural panels. "We used precast concrete for several reasons," she says. "First, it was very economical for the project. It was within our budget. We also used it because it provided what the owner and architect wanted for the look of the building. We also realized that there were many sustainable-

design elements about precast that worked out well for us."

Precast concrete panels can help achieve LEED certification through contributions to a variety of individual credits. They work in conjunction with other design techniques and can vary based on the building's function, site conditions, and other factors. Among the key categories where panels can contribute are:

Durability: Precast concrete panels provide a long service life due to their durable, low-maintenance concrete surfaces. A precast concrete shell can be left in place when the building interior is renovated. Yearly maintenance is minimized inside as well as outside when insulated panels are used. Using precast concrete panels reduces the contributions of solid waste to landfills due to lean manufacturing techniques by the precaster.

Energy Efficiency: Precast concrete sandwich wall panels include an interior layer of high-efficiency insulation between two wythes of concrete, providing a higher effective *R*-value. The inherent thermal mass of the concrete also aids in absorbing heat



The Kettle Foods potato-chip processing plant in Beloit, Wis., used precast concrete insulated panels to help achieve a Gold LEED rating.

Potential Contributions to LEED Points for Structures Using Precast Concrete Panels

LEED Category: Sustainable Sites		
Credit	Pt.	Title and Precast Concrete Contribution
5.1	1	<p>Site Development—<i>Protect or restore habitat.</i></p> <p>A precast concrete building design can help limit site disturbance to prescribed distances from the building. Less dust and waste are created because only needed precast concrete elements are delivered. Fewer trucks and less time are needed because concrete is made off-site. This is particularly beneficial in urban areas. Precast concrete units are normally large components, so greater portions of the building are completed with each activity, creating less disruption. Less noise is generated because concrete is made off-site.</p>

LEED Category: Energy & Atmosphere		
Credit	Pt.	Title and Precast Concrete Contribution
Prerequisite 2	Required	<p>Minimum Energy Performance—<i>Establish the minimum level of energy efficiency for the proposed building and systems.</i></p> <p>Precast concrete's thermal mass and insulated sandwich wall panels help increase energy efficiency.</p>
1.1	1–10 (A minimum of 2 points are required)	<p>Optimize Energy Performance—<i>Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.</i></p> <p>Precast concrete's thermal mass and insulated sandwich wall panels help increase energy efficiency.</p>

LEED Category: Materials & Resources		
Credit	Pt.	Title and Precast Concrete Contribution
1.1	1	<p>Building Reuse—<i>Maintain 75% of existing shell.</i></p> <p>Precast concrete's durability helps it maintain its appearance, so the building shell can remain in place longer. Precast concrete panels can be reused if a building's use changes or for renovation.</p>
1.2	1	<p>Building Reuse—<i>Maintain 95% of existing shell.</i></p> <p>Same as above.</p>
4.1	1	<p>Recycled Content—<i>The post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the project's materials.</i></p> <p>A significant amount of industrial byproducts can be used as supplementary cementitious materials, replacing or supplementing some of the cement in the mixture. Other materials included in precast concrete panels with recycled content include insulation and connection hardware.</p> <p>ASTM C618 provides standards for fly ash, which can be used in quantities of 5% to 65% to replace portland cement. ASTM C989 is for blast-furnace slag, which is used to replace 20% to 70% of the cement in the mixture. ASTM C1240 is for silica fume, which is used in quantities of 5% to 12% to increase concrete strength and provide additional durability.</p>
4.2	1	<p>Recycled Content—<i>An additional credit is available if the project uses 20% post-consumer recycled content.</i></p> <p>Same as above.</p>
5.1	1	<p>Local/Regional Materials—<i>Use a minimum of 10% (based on cost) of the total materials value.</i></p> <p>Most precast concrete components use local material (sand, water, aggregates) and are made at a plant close to the site, saving transportation costs.</p> <p>Precast concrete components are usually transported and erected within 200 miles of the plant, easily meeting the 500-mile LEED requirement. Most precast concrete products are manufactured with materials extracted, harvested, or recovered within 500 miles, such as aggregates, cement, sand, reinforcing steel, and additives.</p>
5.2	1	<p>Local/Regional Materials—<i>Use a minimum of 20% (based on cost) of the total materials value.</i></p> <p>Same as above.</p>

LEED Category: Innovation & Design Process		
Credit(s)	Pts.	Title and Precast Concrete Contribution
1.1–1.4	1–4	<p>Innovation Credits—<i>Apply for other credits demonstrating exceptional performance (must be submitted and approved).</i></p> <p>Precaster can help create innovative systems that achieve key sustainability goals (e.g., use of thin brick reduces material and transportation costs).</p>
2.1	1	<p>LEED Accredited Professional. Some precasters have LEED Accredited Professionals on staff to aid with the design process.</p>



Fact Sheet

Project: Kettle Foods processing plant

Type: Potato-chip processing plant

Location: Beloit, Wis.

Designer/Builder: ACS Inc., with AEI and Fladd Architects

Contractor: ACS Inc., Madison, Wis.

Owner: Kettle Foods, Salem, Ore.

Precaster: The Spancrete Group Inc., Waukesha, Wis.

Size: 73,000 ft²

Precast Components: Insulated sandwich wall panels

Project Cost: \$9.4 million

LEED Rating: Gold

The Kettle Foods potato-chip processing plant in Beloit, Wis., used precast concrete insulated panels to help achieve a Gold LEED rating.

The facility, designed by Affiliated Construction Services, includes wind turbines on the roof to aid with efficiencies.

‘The precast concrete insulated panels are a key factor in achieving LEED certification.’

slowly during the day and releasing it slowly at night when temperatures are cooler, minimizing HVAC costs.

Abundant Materials: Concrete production does not use scarce resources; its raw materials consist primarily of abundant local materials including cement, water, and aggregates. Supplementary cementitious materials such as fly ash, slag cement, and silica fume can replace some cement in the mixture, saving cement and using byproducts that would otherwise go to landfills.

Local Materials: The use of local materials reduces the need for transportation along with its associated energy and emissions. Most precast concrete plants are within 200 miles of a building site. The cement, aggregates, and reinforcing steel used to fabricate precast concrete components are usually obtained or extracted from sources within 200 miles of the plant.

Waste Management: Less material is used because precise mixture proportions and tighter tolerances are achieved. Precast concrete panels can be reused when buildings are expanded, and, at the end of its useful life, precast concrete can be recycled as road base or fill. Concrete from demolished structures can be reused to protect shorelines, while concrete from demolition is recycled.

Air Quality: Concrete contains low to negligible volatile organic compounds. Precast concrete components are delivered to the site in modules that do not require fabrication, processing, or cutting at the construction site, reducing dust and airborne contaminants. Concrete is not damaged by moisture and does not provide nutrients for mold growth. (For more on precast concrete’s attributes, see the accompanying chart.)

Custom-Designed Dealership

Achieving high LEED certification creates challenges, but designers work closely with precasters to ensure that projects exploit every credit possible. That was the case with the new Lexus dealership in St. Louis, says Duitsman.

“Most of the dealerships are rectilinear, but we put a curve into the front that was more challenging to achieve. But when we presented that idea to the owner, he got real excited, and that became the design. It provided a soft, flowing curve that showcases the showroom glass and added an eyebrow of precast concrete at the parapet.” High Concrete in Paxton, Ill., is providing the precast concrete components.

The curved parapet panels were cast with special forms, including a fluted texture. “The fine flute makes the panels more complex, especially



'We recycled 75 tons of aggregate from the cutouts, which resulted in [our achieving] two credits for construction-waste management.'

Helping to achieve the Gold LEED rating at the Kettle Foods plant was a gray-water reclaiming system from the potato-washing process that is used to flush toilets in restrooms.

Photo: ACS

More Information

The Precast/Prestressed Concrete Institute has created a guide to using architectural and structural precast concrete panels, as well as other precast concrete components, to achieve sustainable-design goals. *Designer's Notebook: Sustainability* is a 20-page overview of tips and techniques. It is available from the PCI Bookstore at www.pci.org/publications/designers_notebook.

Additional information about precast concrete parking structures as part of a LEED-certified project is included in the article in the Winter 2008 issue of *Ascent*, which can be viewed online at www.pci.org/publications/ascent.

with the curve," Duitsman explains. The showroom portion uses architectural panels on a steel frame, while the rest of the structure uses insulated panels.

"We used to use precast concrete panels for aesthetic reasons primarily, because owners liked the look," he says. Insulated panels raised concerns about conductivity between the wythes, reducing efficiency, but those technical issues have been resolved with panels now on the market. "The technology has now reached the point where insulated precast concrete panels are a tried and tested system. Performance always is a big factor, and now these panels have reached the point where that is not an issue. They perform well."

The panels also saved on finishing time and expense for interior walls. "If warehouse areas need to be heated and cooled but not finished, precast concrete creates an attractive option, because you put them up and you're finished," he says. "Plus, the inner wythe of concrete provides a great contribution to the energy model for the building."

Fieldhouse Prototype

The Chicago Park District fieldhouse prototype also makes full use of precast concrete's durability and

interior finish. "The client expects the building to last a long time, which makes it more sustainable right away," says Birazzi. "The key is that they don't have a lot of money, so they don't want expensive materials or something that needs to be maintained."

Because of the size of the panels needed to enclose the tall spaces, the designers used composite panels, in which the outer wythe is attached to the inner wythe with concrete ribs, providing more structural support. "We considered noncomposite panels, but for the long spans that were needed, the trusses had to transfer so much load that we needed the additional support to isolate the load as much as possible," explains Birazzi. At press time, no precaster had been selected for the first of the prototypes to be built.

Another benefit of the precast concrete panels is the speed with which the buildings will be enclosed, notes Halik. "They will have the shell in place quickly, with the panels providing insulation as well as an interior and exterior finished wall immediately." The exterior face features a slightly exposed aggregate, with form liners creating articulation that provides shadow lines. "The goal was to create a texture and look that offered a very permanent look, as with a civic

building," he says. "Precast concrete definitely gave us that look very economically."

The finished interior wall provides durability and eliminates the need to paint, Halik adds. "Paint is not very environmentally friendly, so we wanted to avoid it. That's what was so beautiful about using precast—it's so appropriate for the nature of the building, and low maintenance is a key-word for the park district. They don't have a staff to run around taking care of little things. And the buildings get a real workout."

Another key contributor to the Silver (possibly Gold) rating is the geothermal heating and cooling system, which cycles water into tubes that run 500 ft into the ground. "The park district was very excited about doing it here," Halik says. The building also features a heat-reflective metal roof along with a flat area at the middle where an intensive roof garden will be planted. The roof edges were curved to reduce the scale of the buildings, as they will be located in residential neighborhoods, he notes.

The field houses will serve as teaching facilities, with signs explaining the construction and its impact, he says. "They'll be able to see the materials and understand how they were used and why." That includes such specifications as Forest Stewardship Council-certified wood for gym floors.

Gold Food Processing

Kettle Foods also took advantage of a variety of sustainable-design concepts to reach its Gold rating, says Skorpinski. The project includes 10% recycled material, 35% local materials, and an efficient water system that was critical, including using gray water from the potato-washing process to flush toilets in the restrooms. "We were excited to do that because we received innovation and design credits for it."

The project optimized credits available for energy efficiency and material-resource conservation, she notes. The precast concrete panels were specially insulated to increase the R-value, which added to energy optimization. They consist of an 8-in.-thick, interior structural concrete wythe, a continuous 2-in.-thick layer of insulation, and a finished, 2½-in.-thick

wythe of exposed-aggregate-finished concrete.

"Food-processing plants always want to have a nice finish on the inside for cleanability," explains Scott Reay, project manager at The Spancrete Group Inc. in Waukesha, Wis., which provided the precast concrete components. "With a precast concrete wall panel, we can provide that finish and give them an easily cleaned surface that is very appropriate for a food plant."

The panels were used both as load-bearing wall panels and as shear walls, he notes. That approach reduced the amount of steel reinforcement, which minimized the required foundations. "That makes a very efficient use of the product, rather than using it just as a cladding product. It is providing the structure of the building."

Cutouts produced for windows and doors were transported back to the plant for recycling. "We recycled 75 tons of aggregate from the cutouts, which resulted in two credits for construction-waste management, since it accounted for about one-third of the construction-waste recycling effort," says Skorpinski.

Another key ingredient of the sustainable design was the placement of 18 wind turbines on the roof, which will generate enough energy to produce 56,000 bags of potato chips each year. The precast concrete parapet was designed to ensure that it could support this unusual weight, which was easily accommodated with little modification, Reay says.

Kettle Foods executives are pleased with the results, Skorpinski reports, as are the people of Beloit. "It has introduced new jobs to the area, and we understand that the employees are very satisfied with the workplace environment." About 90% of all employees have access to daylight views—a difficult goal to achieve in such facilities, given the amount of space for vats of oil and fryers. "When you can see the sun, it does make you feel better," she says. "It worked out really well."

More designers working on a wider variety of building types are recognizing the benefits that can be provided by precast concrete wall panels as they see them used in more applications. Booth Hansen designers have

used insulated sandwich wall panels on community centers, a trade school, and a college dormitory.

"We've used them on many projects, modifying them to fit the specific application," says Halik. Other Chicago city departments, including school-district officials, as well as officials in other cities, have examined the field-house prototype and similar projects, he notes. "They like that it's economical, simple to build, energy efficient, and easy to maintain. It's a very intriguing approach for this type of building, and offers a lot of options."

HDA's Duitsman agrees. "As energy prices continue to go up, we'll be evaluating the performance of precast concrete insulated panels for use in a variety of projects, including office buildings. Even if the interior surface isn't exposed, they still offer a great value due to their energy efficiency. It's a superior product due to the durability and long-lasting performance, especially if the owner wants to achieve LEED certification. Concrete offers a lot of ways to accumulate points, especially when you look at performance. In that regard, it's pretty superior to other options." ■

For more information on these or other projects, visit www.pci.org/ascent.



Employees at Kettle Foods are pleased with their light-filled facility, an especially difficult factor in a food-processing plant. Photo: ACS

'We had to do everything imaginable to get this to be Gold certified.'