The U.S. Department of Energy National Renewable Energy Lab's research support facility near Golden, Colo., was completed in the summer of 2010. This 218,000 ft² office building holds up to 800 employees and is a showcase for energy efficiency and renewable energy technologies. The energy goal for the building is 25 kBtu/ft²/year. Courtesy of Dennis Schroeder/NREL.

Nation's premier net zero energy building features precast concrete

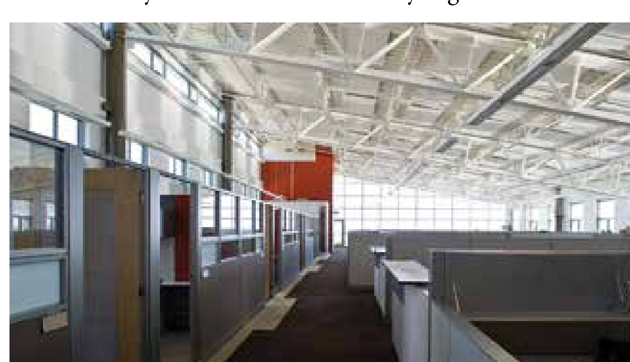
Precast concrete can play an integral role in helping buildings achieve a LEED rating. What may be less well known is that precast concrete can also play an integral role in helping buildings achieve the ultimate in energy efficiency—net zero energy.

One impressive example is the U.S. Department of Energy (DOE) National Renewable Energy Lab's (NREL's) research support facility near Golden, Colo. In designing the facility, the DOE didn't want to simply construct a building that would meet minimum energy code and LEED certification requirements. Instead, it wanted to bring together the best in modern construction methods and building materials to create the most impressive large-scale, net-zero office building in the nation. With the help of insulated precast concrete, it did just that.

The noncomposite precast concrete sandwich wall panels that make up the exterior walls of the research support facility consist of 2 in. (50 mm) of Thermomass System NC insulation sandwiched between 3 in. (75 mm) of architectural finished precast concrete on the outside and 6 in. (150 mm) of finished-surface precast concrete on the inside. The precast concrete panels were fabricated by Rocky Mountain Prestress, based in Denver, Colo.

How did the teamwork between Thermomass and Rocky Mountain Prestress come into being for this project? The architect for the project was Denver-based RNL Design, which had used a lot of architectural precast concrete over the years and had worked frequently with Rocky Mountain Prestress because it had a lot of experience working on green building structures. "Rocky Mountain Prestress then got in touch with us," says Brad Nesset, president of Thermomass. "We have been working with them for almost 30 years on a number of different projects. However, while they had used our products in different applications, it had never been to quite the magnitude that would be involved in this research support facility project, which had a goal of producing more energy than it consumed. This was no easy feat for a 220,000 ft² (20,400 m²) facility."

To ensure success, Thermomass and Rocky Mountain Prestress collaborated on all of the exterior envelope details. "We used Rocky Mountain's finalized production drawings, and we custom-fabricated our insulation system to ensure continuous thermal and moisture protection throughout the building envelope," Nesset says. "We cut around every window and every door and dealt with every edge condition." As



Forty-two miles of tubing run through the U.S. Department of Energy National Renewable Energy Lab's research support facility ceilings to provide radiant heating and cooling. Courtesy of Dennis Schroeder/NREL.

a result, every element that Rocky Mountain Prestress cast ended up being structural, architectural, thermally protected, and moisture protected all in one. "Once they were erected, there was no need for any other interior or exterior finish treatment," he says.

The finished wall panels not only provide durable surfaces to protect the building from the effects of weather extremes but are also part of the building's innovative passive heating and cooling operations—storing and expelling thermal energy as needed throughout each 24-hour cycle. "The building is set up to optimize the thermal mass effect, which means that the building knows when it can absorb internal and external energy to heat or cool," Nesset says.

Because the exterior layer of precast concrete is completely decoupled from the interior layer by the insulation and fiber-composite connectors that secure the layers together, the exterior layer acts completely independently of the interior layer, both structurally and thermally. During the day, the interior wythe of the insulated panels absorbs the heat generated by the computers, printers, and workers' body heat. Then, each night, the windows automatically open to vent that heat and allow the cool night air to naturally lower the temperature inside the office space. At the same time, the 6 in. (150 mm) of internal precast concrete panels lose any of the heat they stored during the day and begin to cool down, ready for the next day.

In addition to thermal performance, to aid in the expedited construction schedule, 90% of the windows were delivered directly to the Rocky Mountain Prestress yard, where they were installed, glazed, caulked, and anchored into the precast concrete panels before delivery to the research support facility building site in Golden.

The building has been the success that it was originally designed to be. "Since the building has been commissioned and is operational, the DOE has been able to show that it is operating as designed—actually producing more energy than it consumes," Nesset says. "While it was a prototype and the first of its kind in the nation, it is now a benchmark for future office buildings."

—William Atkinson

Precast concrete meets solar panels in a military base parking structure

Over the past three-plus years, Metromont Corp. in Greenville, S.C., has provided the precast concrete for four parking structure projects at Camp LeJeune, a 246 mi^2 (637 km^2) U.S. Marine Corps base in Jacksonville, N.C. The parking structures range in size from one story to four stories, and all of them feature solar panels on the top decks. The smallest project involved 306 pieces of precast concrete with 2153 yd^3 (1646 m^3) of concrete. The largest involved 556 pieces with 5135 yd^3 (3626 m^3) of concrete.

"These were all design-build projects, and each of them had a different general contractor," says Tony Smith, vice president of preconstruction and marketing for Metromont. Metromont actually won the four projects in two different ways. "The military put out bids to the general contractors with the basis of design included and then left it up to the general contractors to meet overall design intents," he says. Subsequently, in a couple of instances, the general contractors awarded the precast concrete work to Metromont as a result of the assistance it had provided to the general contractors in helping them get the projects in the first place. In other instances, the general contractors that were awarded the contracts then bid out the precast concrete work, and Metromont won those. The contracts for the four projects were awarded from late 2011 to late 2012, and the projects were completed between 2014 and 2015.

Metromont's involvement in each project began with a preconstruction kickoff meeting with the general contractor's design team to determine team-member responsibilites, deadlines, and other preliminary planning.

However, Metromont's real key to success on these projects was working closely with the subcontractors. "This coordination was particularly important because of the number of nonstandard attachments to the precast that were involved," he says. In fact, Smith says, nonstandard attachments are actually becoming more common in their work these days, rather than the exception. Coordination with the solar panel subcontractor was particularly important for a number of reasons:

- Placing of electrical conduit was important. "We had to discuss its placement in relation to the cast and the precast concrete to make sure the electrical could be run where it needed to go," Smith says.
- The loading effects that the solar panels had on the precast concrete were also vitally important. "With solar panels, sometimes the problem is not so much the dead load that is created but the uplift that is created," Smith says. "The panels are at an angle, so when there is wind it can cause uplift. We had to make sure that the connections would be able to handle this."
- Along the same lines, discussions had to take place regarding the embedments and the spacing of the embedments.

All of this was a team effort, Smith says. Metromont and the solar subcontractor worked on these issues together. For example, the solar panels were set on steel-framing systems that would bear on the precast concrete walls and columns.

Another concern was related to security on the military base. For example, all subcontractor employees entering the project site had to pass background checks. "In addition, all of the trucks had to go through a security checkpoint, so we needed to schedule the loads so they would have time to get through the checkpoints," Smith says. In addition, because of the security checkpoint process and the proximity to the plant, in some instances, Metromont staged the project inside the security perimeter. In other instances, it staged the project outside the security perimeter. In both cases, a shuttle would then deliver the product from the drop lot to the crane.

—William Atkinson