

PROJECT SPOTLIGHT

NetZero Precast Concrete Duplex first of its kind

As a result of a joint effort among Lafarge Canada, Stantec Design, and Habitat for Humanity, Edmonton, AB, Canada, got a one-of-a-kind precast concrete duplex.

The NetZero Precast Concrete Duplex is home to two families. The structure is unique because it is LEED-certified platinum from the Canadian Green Buildings Council (CaGBC) and it is the first precast concrete home in Canada to be designed and built for net-zero energy. A net-zero building is defined as a building that generates at least as much energy as it consumes over the course of 12 consecutive months.

“Our initial goal, besides proving that precast could compete with wood, was to get some data on the performance of precast thermal mass,” says Don Zakariasen, director of marketing for Concrete Products at Lafarge Canada in Calgary, AB. “We then realized that we could actually build the duplex to be net-zero energy.”

The entire building envelope is constructed of two types of concrete. Hollow-core precast concrete slabs were used for the walls and roof and ensure an airtight and energy-efficient building envelope. Ready-mixed concrete was used for the footings and the basement floor slab.

Non-load-bearing walls are 14 in. (360 mm) thick. “These walls have 3 in. (75 mm) of precast on the inside, 8 in. (200 mm) of continuous insulation in between, and 3 in. of precast on the outside,” Zakariasen says. The load-bearing walls are 17 in. (430 mm) thick and are similar to the 14 in. walls except that they have 6 in. (150 mm) of precast concrete on the inside.

The roof is 12 in. (300 mm) thick hollow-core, which spans from front to back. It is covered with a vapor barrier membrane, and on top of that is 16 in. (410 mm) of insulation, which is also covered with membrane.

While the average home has an R -value between 16 and 20, this duplex has wall panels with an R -value of 44 and a roof with an R -value of 88.

The Lafarge Canada plant in Edmonton manufactured the precast concrete walls. “The building also uses Lafarge gypsum for the interior walls,” Zakariasen says.

The precast concrete system retains heat from the sun during the day and releases it at night. Two 3.78 kW photovoltaic solar panels on the roof are used for heating and are expected to be able to generate 15,000 kWh of electricity over the course



Lafarge Canada, Stantec Design, and Habitat for Humanity collaborated on this NetZero Precast Concrete Duplex in Edmonton, AB, Canada, a two-family home that generates at least as much energy it consumes over the course of 12 consecutive months. Courtesy of Tucker Photography.

of 12 months for heating in the winter, cooling in the summer, hot water, and other electricity needs. During the summer months, with the solar panels fully active, the system returns power to the grid, and during the winter, the duplex relies more heavily on the electricity grid for power. A geothermal pump for heating and cooling is integrated with the solar panels.

The duplex was designed and built not only to be practical but also to be visually appealing, with contrasts between color and texture. “For example, there is a postapplied paint coating on the outside,” Zakariasen said.

Additional benefits of precast concrete, of course, include increased fire resistance, durability and longevity, and soundproofing. “When you are inside and the windows are closed, you really can’t hear a sound from outside,” Zakariasen says.

The project started in late 2011, and in late 2014, two families moved in. “The duplex is wired with sensors that send information back to the Massachusetts Institute of Technology, which is collecting and analyzing the data and will then issue a report at the end of two years on the building operation and the interaction of thermal mass with the mechanical and electrical systems,” he says.

The duplex was designed as a prototype, with the idea that it will soon be able to be mass produced at lower costs. “We are already using a lot of the knowledge we have gained from this project in some other multifamily applications, which is where our primary focus will be in the near future,” Zakariasen says.

—William Atkinson

City of Loveland uses precast concrete for aesthetics and performance

RNL Design, an architectural firm based in Denver, Colo., has been designing structures for the city of Loveland, Colo., since the early 1980s. Recently, RNL was once again selected to design additional service center expansions, including four new buildings for the city's public works department.

"These included an office building, two maintenance buildings, and a fourth very small structure," says Dale Hammond, senior project manager for Denver-based Stresscon, which provided the precast concrete panels for the projects.

Although aesthetics were important, there were four important performance goals. Those performance goals are why RNL opted for precast concrete. RNL wanted to provide high levels of thermal resistance and reduced energy costs, create durable structures that would blend in well with the existing campus buildings, be able to erect the buildings as quickly as possible with minimal disruption to the active service center campus, and ensure that the structures would require little to no maintenance over time. Precast concrete allowed the project to achieve all four of these goals and more.

Stresscon provided 221 pieces, including Thermomass, Dynaspan, double tees, insulated walls, wall panels, and insulated truss walls. The 12 in. (300 mm) thick Thermomass wall panels were produced at a long-line production facility, allowing for prestressing of the walls to maximize the structural capacity and create an economical wall panel.

In terms of energy performance, the panels are designed and built to achieve a steady-state *R*-value, ensuring project economies and insulation requirements, and are also designed and built to guard against weather infiltration at the joints.

"On the main office building, we provided architectural panels using the Thermomass system with 12 in. walls and continuous insulation with *R*-22 insulation value," Hammond says.

"The insulated precast concrete panels achieved energy performance requirements by acting as a high-performance building envelope," says Jonathan Flager, a registered architect with RNL Design.

In terms of durability, the panels were designed and built to guard against lateral wind forces.

Also, because the panels were cast off-site, erection time was reduced and work area disruptions were limited. "The panels were erected during early winter months in below-freezing temperatures, when other traditional building envelope systems would not have been able to be constructed," Flager says.

Flager says that in terms of maintenance, "more than one year after substantial completion, the panels look great aesthetically and remain low maintenance, durable, and energy efficient."



The exterior of the city of Loveland's new public works building shows the design of the formliner pattern. Courtesy of EnCon United.



Stresscon used a decorative formliner for the new city of Loveland public works main office building entrance in Colorado. In addition to aesthetics, precast concrete also provided energy savings, durability, quick erection, and low maintenance. Courtesy of EnCon United.

There ended up being benefits beyond the original four performance goals. "One was that the panels were able to provide structural support," Flager says. In fact, the load-bearing nature of the panels eliminated the need for internal columns, providing maximum workspace.

Although performance was paramount, aesthetics were not compromised. The designers were able to ensure uniform building envelopes with multiple colors and simple detailing with gray and white acid-etched designs that match nearby building color schemes.

—William Atkinson 