Thin is In

New hybrid thin-shell precast wall systems do more *and* less.

BY MICHAEL CHUSID, RA, FCSI

PHOTOS COURTESY METAL STUD CRETE

Precasters captured the neo-classical architecture of the Huntington Library and replicated it for the new Munger Research Center on the Library's San Marino, Calif., campus. Read more about this project ("Blending In") in the Precast Solutions *Weekly archive, www.precast.org/weekly.*

In a world where one can never be too thin, too strong or too beautiful, thin-shell precast concrete is a step closer to that ideal. In the past, the heavy weight of concrete – and the costs associated with lifting and transporting that weight – have limited the use of precast. Innovative fabrication techniques, however, now make it possible to reduce the weight of precast concrete walls.

This new breed of precast is accomplished through hybridization, combining the best characteristics of two separate building materials. Thin-shell precast panels, also known as "studcast" precast, are made by marrying as little as 2 inches of concrete to light-gauge, cold-formed steel framing. The concrete provides a durable and attractive skin available in the designer's choice of color and texture and the steel studs provide the structural bones of the wall.

The steel studs are assembled into panels and then integrally connected to concrete during the precasting process. Together, they create a wall that is both more and less than the sum of their parts:

Because the two materials create a structural composite that can outperform either material used by itself. The steel resists axial and transverse loads, and the concrete stiffens the steel and provides a diaphragm to resist in-plane forces. This means thin-shell precast can be used for structurally efficient load-bearing walls as well as for cladding and curtainwalls.

Thin-shell precast uses up to 75 percent less concrete than the 4 to 8 inches of concrete thickness in conventional precast panels. This means a thin-wall weighs about 35 pounds per square foot (psf) including the framing instead of 100 psf. And if a cellular concrete mix is used, the wall can weigh as little as 12 psf. With these reduced dead loads, a precast thin-shell wall weighs less than a concrete masonry wall and can compare even with construction materials like stucco on wood framing. The light weight affects the entire structure, saving money and materials from the foundation upward.

Precast construction speeds up project schedules by fabricating walls off site while the foundations and superstructure are being prepared. Prefabrication also allows a building to be enclosed sooner so other trades can work out of the weather.

Thin-shell systems have additional time advantages. Construction, for example, is simplified because one can use lighter weight equipment to lift the panels or opt to use fewer but larger panels. Panels as big as 16 feet by 40 feet have been used. Either approach can reduce the size or number of connections that have to be made between a wall and the adjacent construction.

Furthermore, thin-shell walls eliminate the requirement to install furring on the inside of the walls. That's because a thin-shell wall's metal studs provide ready-made cavities for insulation and utilities and are ready for the attachment of interior finishes. Eliminating wall furring also reclaims several inches of floor space

around the entire perimeter of the building to increase the building's net usable area.

These economies make thin-shell cost-competitive with other forms of construction, which have previously dominated many markets, including housing, commercial, industrial and institutional buildings. Added to this is a long list of other benefits.

Concrete and steel hybrid panels score high marks for safety and durability. There are a number of tested designs for fire-resistant thin-wall systems. Both steel and concrete are non-combustible, enabling a building owner to qualify for lower fire insurance underwriting.

Structurally, the composite panels can be engineered to survive hurricane-force winds. And their seismic resistance is improved by the reduced mass of the thin-shell walls. In addition, concrete and steel are impervious to mold and termites, and galvanized steel is generally used for corrosion resistance.

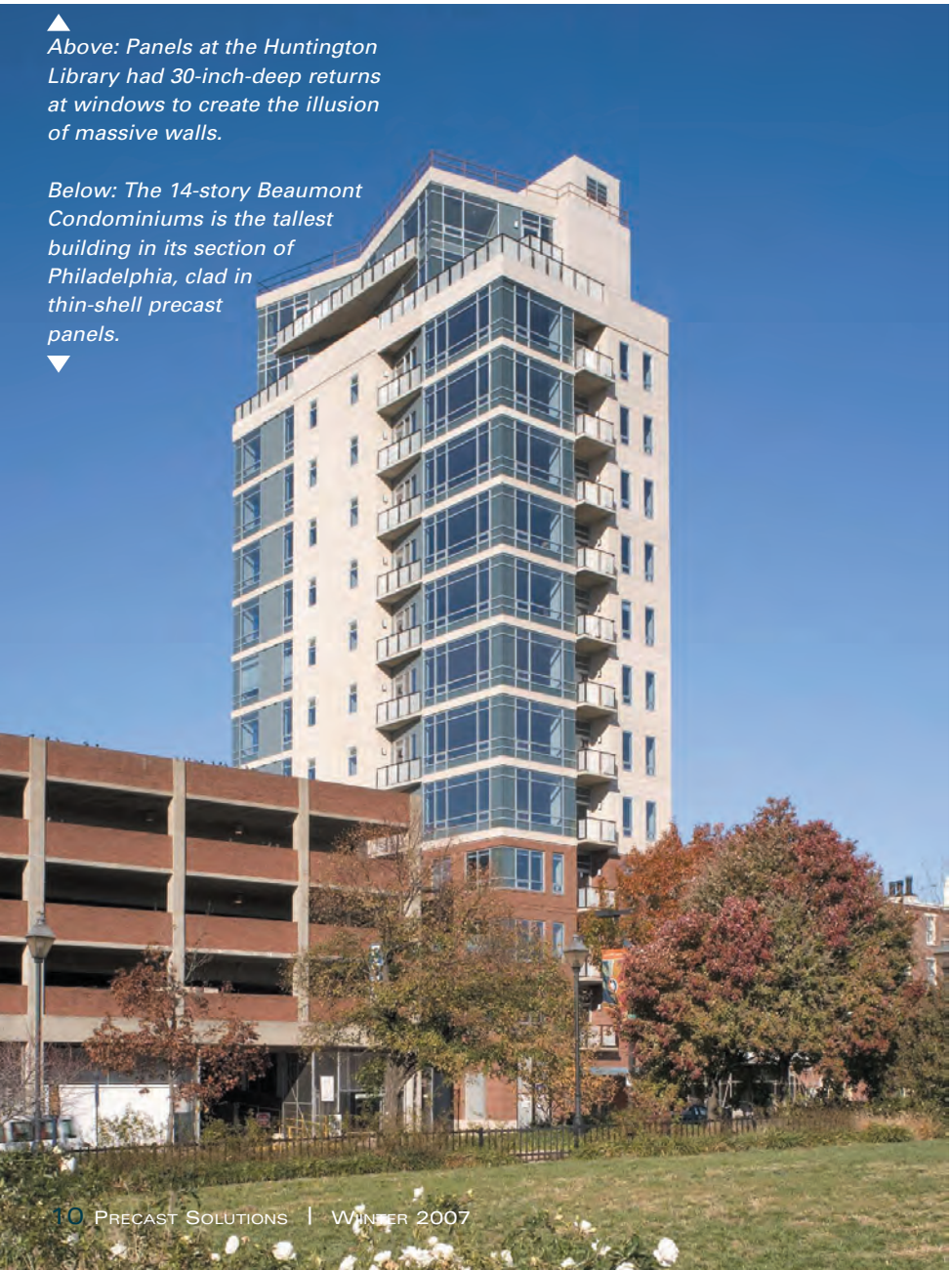
Moreover, the potentially larger panels have fewer panel joints to seal against air and moisture infiltration, improving thermal control. A wide variety of architectural finishes and surface details are available.

Environmentally, thin-shell systems are suitable for "green" construction and can help a project qualify for credits under the U.S. Green Building Council's LEED program. Consider:

Recycled Content: Most steel produced in this country has significant recycled content. And fly ash or

Above: Panels at the Huntington Library had 30-inch-deep returns at windows to create the illusion of massive walls.

Below: The 14-story Beaumont Condominiums is the tallest building in its section of Philadelphia, clad in thin-shell precast panels.



other supplementary cementitious materials can be used in concrete. When the building is eventually demolished, the steel and concrete can be readily separated for recycling.

Locally Available Products: Most precast panels are locally produced using locally extracted raw materials.

Energy Efficiency: Studs up to 6 inches deep can be used to accommodate additional insulation. Studs are also available with "open webs" that decrease thermal losses through the steel. More large panel sizes, possible with thin-shell systems, decrease the number of joints in a wall to reduce air infiltration and exfiltration.

Innovation Credit – Greenhouse Gases: By cutting the quantity of concrete used for precast, thin-shell reduces the amount of CO2 emissions – a major greenhouse gas – associated with the portland cement produced for the project.

Innovation Credit – Transportation: While the weight of conventional precast typically limits the number of panels that can be loaded on a truck, lighter weight thin-shell precast allows two or more times as many panels per truckload. This dramatically cuts fuel consumption, air pollution, tire wear and other environmental impacts.

While some thin-shell systems have a two-decades-long track record of successful use, recent innovations and the desire for better and more affordable buildings have sparked growing interest in the concept. The accompanying articles look at two different systems that suggest the range of opportunities offered by thin-shell precast. They differ in the kind of concrete they employ and the way they attach concrete to steel. This in turn creates different strengths and options. The more closely you examine the details, the more possibilities you find.

See the Spring 2007 issue of *Precast Solutions* to learnb about Ecolite, a new type of studcast precast made with lightweight cellular concrete for improved thermal properties and fire resistance.

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