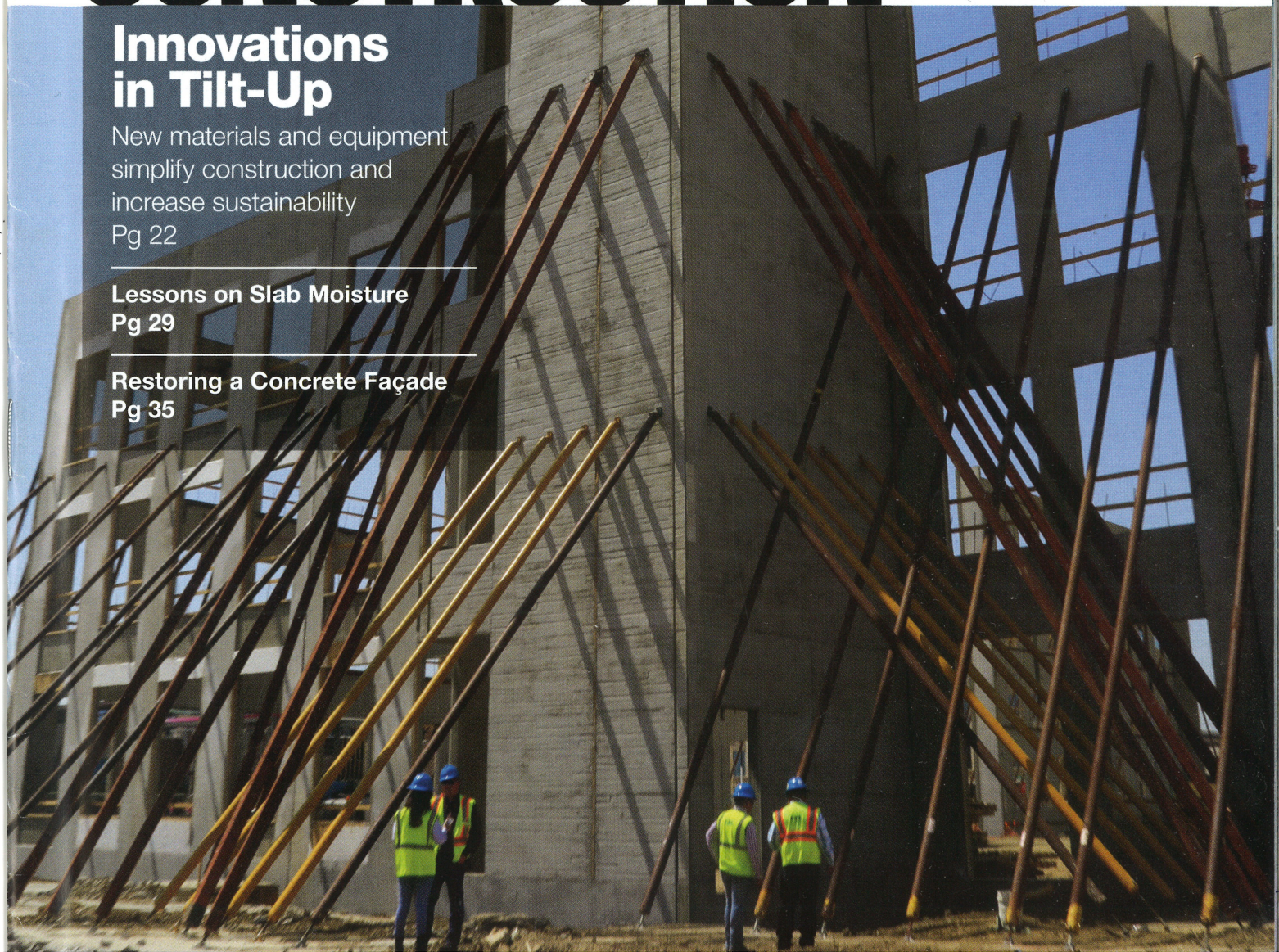
INSIDE: CONCRETE SURFACES

July/August 2019

CONCRETE CONSTRUCTION

An Official Magazine of
World of Concrete

WORLD OF CONCRETE®



Innovations in Tilt-Up

New materials and equipment simplify construction and increase sustainability
Pg 22

Lessons on Slab Moisture
Pg 29

Restoring a Concrete Façade
Pg 35

TILT-UP INNOVATIONS

New materials and equipment can simplify construction and increase sustainability.

The heavy concrete elements in the Walking Assembly are easily moved by hand thanks to the precise manipulation of the center of mass.

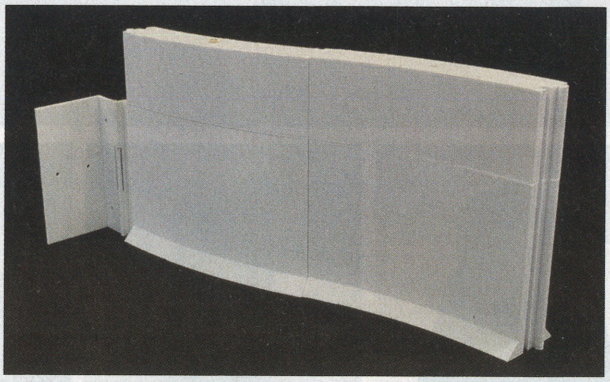
BY BILL PALMER || **GREAT IDEAS FOR** construction seldom emerge quickly but rather are presented as promising ideas that are considered, argued over, and finally adopted. At the recent FutureThink session presented by the Tilt-Up Concrete Association, presenters of a series of short talks each described an emerging idea that an expert panel and the audience then questioned and criticized. Topics ranged from bionic construction workers (with exoskeletons) to rebar-tying drones to 3D printing. Here are summaries of three of the presentations.

Curvilinear Edge Forms

This idea is simple yet creative, which is not surprising coming from Jeffrey Brown, an architect who leads the concrete industry in innovative tilt-up buildings. His 2014 book *Tiltwallism* is the definitive architectural idea book on the subject. The device Brown described at FutureThink is curved sections of edge forms for tilt-up panels.

Before he got to that, Brown started his presentation with a discussion of why innovative ideas are difficult to get through to the majority of architects. "If you look at the structure of architecture," he said, "there are the top architects (the Starchitects) that are less than 5% of all firms and do less than 2% of all projects. Then there are the 20% of firms that I call 'the branded band,' the HOKs and SOMs, that employ about 80% of the architects and do 55% to 60% of all billing. And then at the bottom are everyday architects that are about 75% of the firms and do the widest bandwidth of building types. The lower-level guys want to replicate what the Starchitects are doing but they don't have the budget and need products to help them do that. So we are thinking about tilt-wall for the guys who aren't doing the extravagant stuff and how to create products for them."

To that end, he came up with side forms that can be used to make curved edges for windows or panel edges. Traditionally, this has been accomplished with foam or with flexible forms that are staked into position, but those curves cannot be reliably repeated and are not very precise in the curvature they create. So if you are designing a curved concrete panel opening that will have a window installed, and the curve varies, that presents a serious problem. The lower-level architects don't have the budget to get curved edges like the top guys do, but with these simple forms they now could.



Using curved edge forms with only three different radii and a hinge connector allows endless possibilities for precise and repeatable curved edges on tilt-up panels.

"You just need dimensionally stable forms, a strong marketing campaign, and someone to make them and distribute them," Brown said. "You need to be able to reliably repeat the curve, and this system is simple: It's just three stackable radii; that's all it takes. It can then be assembled as closed forms for openings or panel edges."

These edge forms have not yet been manufactured but, with such a simple but useful idea, it seems likely they soon will be.

CarbonCure

Concrete, due to its use of portland cement, is a major carbon emitter. On the other hand, there is no material available today that can come close to its versatility and usefulness. This conflict creates a dilemma in how to reduce concrete's carbon footprint, and that's where CarbonCure comes in. While this is not exclusively a tilt-up issue, it is an issue for the entire concrete industry since many owners these days are looking for ways to make their buildings more sustainable.

"CarbonCure is simple," said Ted Jones, the company's vice president of sales and marketing. "The way it's put into the concrete is very similar to the way an admixture is used. It's a patented technology where CO_2 is directly injected into the back of the truck or directly into the central mixer at a wet batch plant. The CO_2 is converted into a mineral and it improves the compressive strength of the concrete."

"The chemistry is pretty simple," he continued. "Cement is made using limestone through a calcination process. When you inject the CO_2, it's a reverse calcination reaction that creates calcium carbonate, which is basically limestone. The difference is that it's a nano-sized particle so it creates nucleation sites for the cement to hydrate more efficiently. There's a 10% to 15% strength gain from adding the CO_2 which allows the ready-mix producer to reduce the cement in the mix by about 25 pounds per cubic yard without giving up any strength. There is no impact on workability or pumpability—we've done blind tests with finishers and they haven't seen any issues. It's the same concrete, but even slightly increased durability. The producers that have gotten into this did it because they want to be a leader. If you can get concrete at the same price that is more sustainable, why wouldn't you do it?"

Injecting CO_2 as the fifth ingredient in a concrete mix results in higher strength and a lower carbon footprint.

While only 1 pound of CO_2 is used per cubic yard of concrete, combined with the reduction in cement, it is saving about 25 pounds of CO_2 per cubic yard. Currently there are several major concrete producers who are using CarbonCure, including Ozinga Brothers in Chicago and Thomas Concrete in Atlanta, and there are 140 plants equipped with the CarbonCure technology.

Walking Assembly

A collaborative effort between Matter Design, an architectural research group, and CEMEX Global R&D, a team from that partnership presented a concept where massive concrete elements (such as tilt-up panels) can be moved with significantly less energy. The mysterious knowledge surrounding the transportation and placement of megalithic structures of the past, such as Stonehenge, eludes contemporary building practices. The Walking Assembly reintroduces the potential of that ancient knowledge to better inform the transportation and assembly of buildings.

A brick is designed for a single hand, and a concrete masonry unit for two, but these massive masonry units unshackle the dependency between size and the human body. Intelligent transportation and assembly is designed into the elements themselves, liberating humans to guide these colossal concrete elements into place. Structures that would otherwise rely on cranes or heavy equipment can now be intelligently assembled and disassembled with little energy. By using variable density concrete, the center of mass of the object is calibrated precisely to control the stable, but easy, motion of the elements. This ensures that these massive elements successfully walk and assemble into place, creating the possibility for a crane-less tilt-up construction method.

"How things are transported and assembled should be built into the objects themselves," said Matter Design's Brandon Clifford. Cemex has taken on the task of manipulating the density of concrete while maintaining full structural strength, said Davide Zampini, director of global R&D and IP management for Cemex. Even pervious concrete can have high strength so that it could be used to make movable concrete elements. **CC**

Go to concreteconstruction.net to see a video of these large pieces being assembled.

The pieces fit together like a puzzle to create a massive concrete stairway.