At Home with Precast Concrete // Finding Form // Taking Comfort in Precast

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ON THE COVER:
The MARS Pavilion was manufactured using programmable robots and fabric forms. Its creators have now set their sights on commercial applications.

Photo courtesy of Form Found Design.

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WHAT'S INSIDE

Photo courtesy of Form Found Design

A Sure Bet with

Precast concrete proves to be a timely, environmentally sound option for a monumental entertainment venue accenting the skyline just outside the nation's capital.

By Deborah Huso

Photo courtesy of Alex Fradkin, Courtesy of SmithGroupJJR

The award-winning and LEED-certified MGM National Harbor features 1,200 architectural precast pieces.

n Precast


BLOSSOM AND FELT LOUNGES: SERVING UP
ONCE IN A LIFETIME NIGHTS, NIGHTLY.
MGM

Just across the Potomac River from the nation's capital, the MGM National Harbor, a $1.4 billion hotel and casino in Prince George's County, Md., has redefined the skyline. The project met ambitious goals for sustainability in both construction and performance, which earned it the U.S. Green Building Council's LEED Gold certification.

The project also won a Washington Building Congress 2017 Craftsman Award for visual excellence thanks to 1,200 profiles and panels of architectural precast concrete. WBC recognized the structure's 300,000 square feet of precast not only for its grand scale but also for the level of complexity.

PRECAST HELPS MGM MEET THE GOLD STANDARD

HKS Architect's Houston office served as the design architect, capturing the client's vision for a grand entertainment venue, while SmithGroupJJR of Washington, D.C., was responsible for analysis of the design and optimizing performance. The designers prioritized environmentally preferred technologies and materials, including the use of precast concrete.

Precast was the logical material for a building of such scale with sustainable design goals. While precast provides the feel of stone, it allowed the design to stay within a reasonable budget and reduce energy usage and waste during construction compared with actual stone.

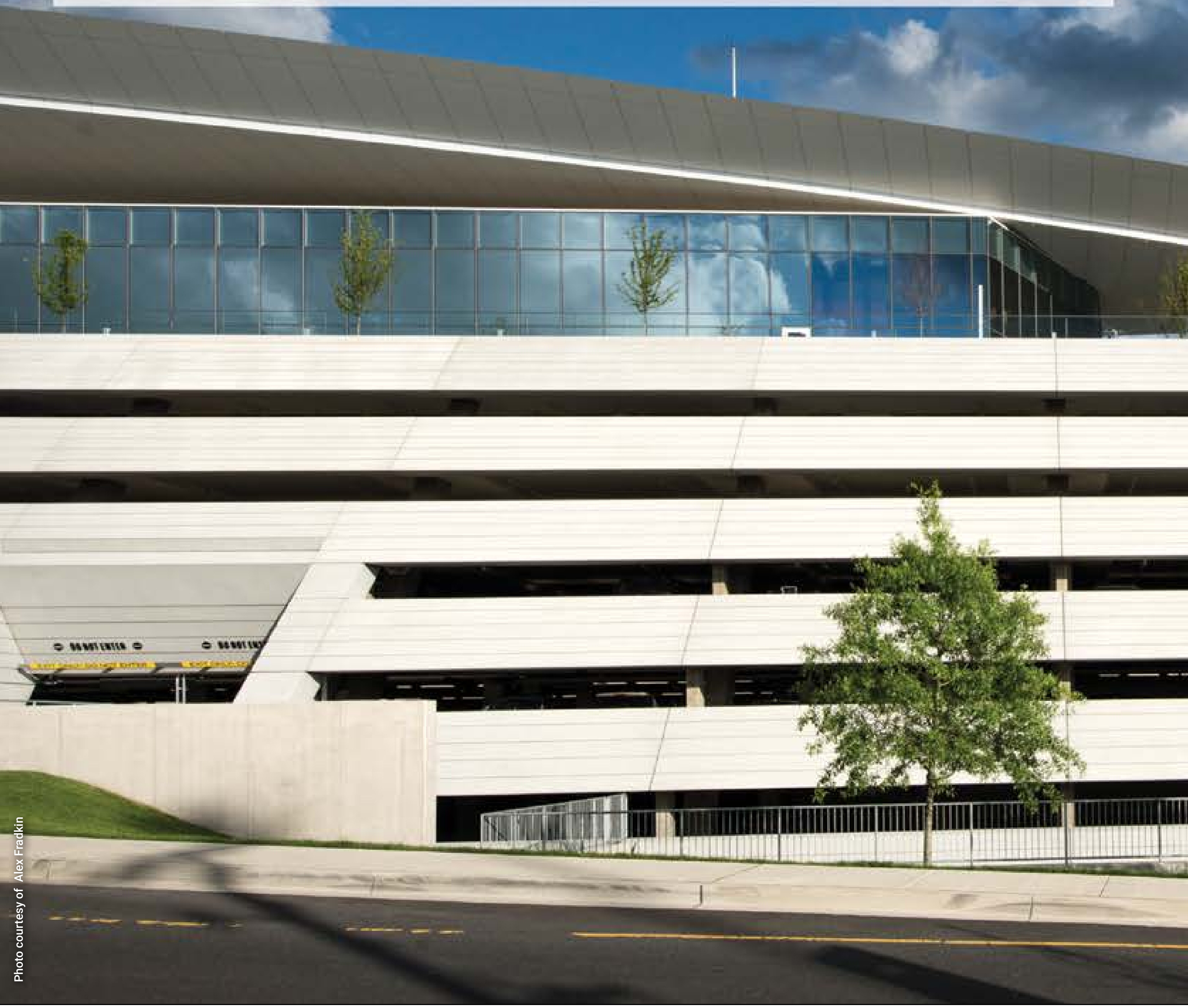


Photo courtesy of Alex Fradkin

Greg Mella, SmithGroupJJR's director of Sustainability, said demands for performance and environmental sustainability also had to meet high standards for construction and materials. Additionally, pressure came from the ambitious timeline of 30 months. Mella said documentation and verification for each decision was essential, from design to construction.

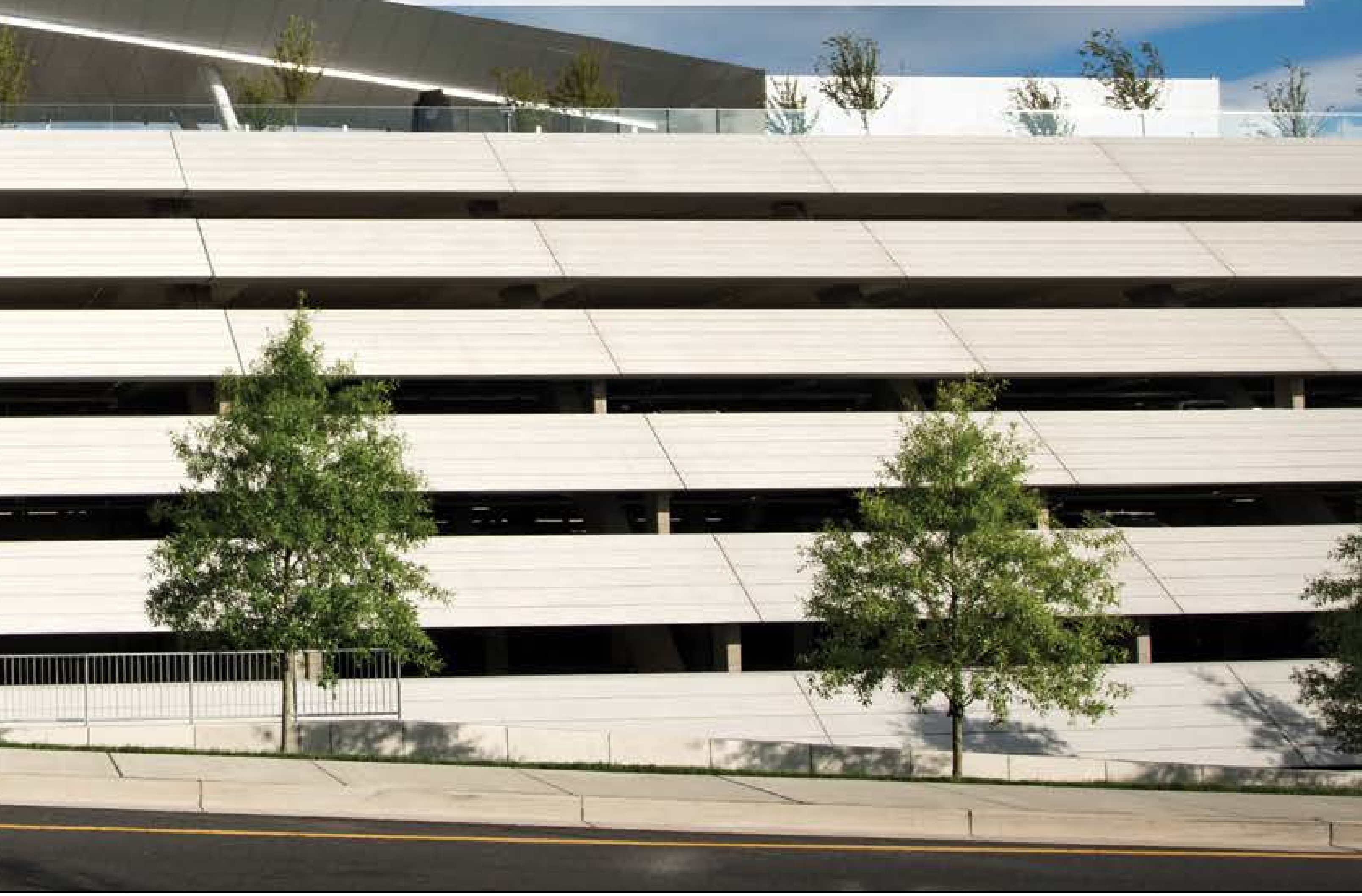
"A lot of our strategy was coming up with a manual, a kind of matrix, which made very clear what we were trying to accomplish with material selection and provided a means where each designer could document his or her choices, and how they contributed to the goals for the project," he said. "Precast was part of our plan to maximize use of local materials to support the local economy as well as to minimize the life-cycle impact of production."

The 1,200 profiles and panels of architectural precast clad the plinth, a stepped structure serving as the dramatic base for the complex and housing for the tiered parking garage. The use of precast panels reduced job site construction waste and increased the speed of construction. Assembly of the precast panels generated less waste compared with cast-in-place concrete as well.

The proximity of the precast plant to the construction site also earned points toward LEED Gold certification. Precaster Arban & Carosi's plant was just 20 miles from the construction site, falling well within the 500-mile allowable radius needed to qualify the precast as an environmentally preferred product. Not only did the plant's location lead to lower levels of pollution from vehicle operation and ancillary vehicle waste associated with refueling, vehicle manufacturing and eventual disposal, but less energy was used in production. Fabricators can optimize the replication of pieces using the same form, as compared to on-site fabrication where each structure requires an assembled individual form.

A MONUMENT TO MONUMENTS

The 1.7 million square foot MGM National Harbor's exterior echoes those of Washington monuments, mirroring the steps of the Lincoln and Jefferson Memorials. The parking levels are clad in tiered, angled columns of precast set at a 45-degree incline. This leverages the natural 95-foot rise in elevation of the landscape from west to east, giving visitors a grand entrance while elegantly incorporating a 5,000-car parking structure inside.



Precast concrete profiles and panels clad the plinth, a stepped structure housing the parking garage.

Positioning the parking facility underneath the entertainment complex also mitigates the urban heat island effect by decreasing solar energy gains. Above, the structure rises 23 stories. The effect is a striking monument of engineering.

Eddie Abeyta, HKS Principal and Design Director, said the design of MGM National Harbor serves as a gateway into Maryland from Washington, D.C., reflecting its proximity to the monuments on the National Mall and the rolling hills of Maryland.

Photo courtesy of Alex Fradkin, Courtesy of SmithGroupJJR

AWE-INSPIRING SCALE AND MAGNITUDE

Now in place, the precast panels' individual scale and magnitude can be difficult to appreciate. However, as each of the approximately 30-foot-long and 7-foot-tall panels arrived to the waiting cranes on the job site, the scale was anything but forgettable. Despite the size, the installation process went like clockwork.

Abeyta remembers watching this process. Struck by the efficiency, he casually checked the length of time it took to move each panel by crane from the flatbed and then rotate it into place where a waiting welder secured it in place. The process, from flatbed to welding, took about five minutes for each massive panel.

"That's the beauty of modular construction," Abeyta said. "All of the embodied energy is produced ahead of time. The construction process goes quickly and quality control is easier to maintain."

The finished product includes 2.2 million square feet of covered, below-grade parking clad in architectural precast. The horizontal expanse of bright white tiers practically floats on the Potomac River when lit at night, blending effortlessly into the sophistication that marks both the historical and contemporary buildings across the river.

"As soon as you start hitting that bridge (from D.C.), you're going to see MGM," Robert Stowe, vice president of facilities at MGM National Harbor told the Washington Business Journal during a mid-construction video interview. "We don't need any billboards. The billboard is going to be the building." **PS**

Deborah Huso is a freelance writer specializing in construction, real estate, finance and agriculture.

At Home with Precast Concre

Precast concrete makes its mark in the residential construction market thanks to its versatility, durability, low maintenance costs and aesthetic qualities.

By Shari Held

Photo courtesy of Northeast Precast


ete

Off-site production of the wall products enabled crews on-site to assemble the house quickly.

Precast concrete homes may not yet be mainstream, but every day more residential architects, builders and homeowners are discovering what precasters and their customers have long known – building with precast concrete offers advantages during all stages of the project and beyond.

Precast played a starring role in two custom-built homes that represent very different styles in markets thousands of miles apart. The common tie is how using precast simplified the process and created a beautiful and durable home.

DESIGNING A DREAM HOME WITH PRECAST

The time between a homeowner's vision and the completed home is filled with hundreds of decisions and details. But it all begins with the design.

The Faichtygers, first-time homeowners, wanted their dream home to have an open, unobstructed feel but they were concerned about the home's structural integrity and sound transmission. Architect John Pedersen of J. W. Pedersen Architect in Vineland, N.J., satisfied both concerns by designing the home with precast concrete supplied by Northeast Precast in Millville, N.J.

The precast floor planks, used on the first and second floors, cover a continuous 28 feet – the entire width of the home. That wouldn't have been possible with wood floor joists.

"Normally in a home of this width, you'd have a center beam on every floor or walls that support the floors," said Kenneth Baur, P.E, engineering consultant for Northeast Precast. "But prestressing this precast floor system enables you to create long spans with light section weights and not have problems with cracking. And since the planks are insulated, there's very little sound transmission between levels."

The precast floor system eliminated the need for typical load-bearing walls, making it easier for Pedersen to design the open concept, and its precision aided in the design process. Additionally, if the Faichtygers want to remodel in the future, the walls can be reconfigured to accommodate a new design.

"Precast is manufactured in the factory, as compared to cast-in-place concrete, so there's high quality control," Pedersen said.

High quality control and attention to detail helped Northeast Precast fabricate the most challenging piece – a gable wall with windows. Gabled walls are not typically made from precast, even in structures built primarily with precast. Northeast Precast had to build a custom form to accommodate the heavily reinforced wall.

"We make 1,000 linear feet of walls every day, but they don't look like that," said Tom Talalaj, general manager of the Superior Wall Division for Northeast. "It was a bit of a design challenge for us but we deliver a finished design product before we build anything. We work out the kinks to come up with something that's workable within the parameters of the realities of precast."

The gable wall was a pivotal structural piece since it had to resist strong New Jersey lateral wind loads. In the future, Baur anticipates windows will be installed during the fabrication phase, which would enable the contractor to close in the building as they erect the walls.

Precast concrete homes offer unmatched durability and resiliency, as well as efficient construction.

FASTER CONSTRUCTION AND MORE

Within a matter of days, Northeast Precast fabricated the 11 floor planks – 28 feet long by an average of 8 feet wide – and 36 wall panels – ranging from 9 to 13 feet in height and 10 to 14 feet in width – to create the precast structure.

Precast's many advantages, especially speed, took center stage on-site. It took workers only two days to build the precast shell. Within a week, the entire home was under one roof and weather tight – a feat that would have taken months if the home had a poured basement, wood framing and a wood floor system.

"With all the forethought put into the design during the design phase, prior to production, the installation went off without a hitch," Talalaj said.

Using precast also helped reduce the number of on-site tradespeople during the construction phase – something the Faichtygers appreciated. That was especially evident in the decision to precast the gable wall.

But that was just the beginning of the advantages of using precast. The precast walls feature built-in chases in each galvanized metal stud, making them instantly ready for wiring and plumbing. In addition, each stud includes a facer so workers could easily and quickly attach drywall panels.

Less insulation is needed to meet code requirements in a total precast home as well. Expanded polystyrene foam is integrated into the precast floor system during the fabrication process and the wall system features uninterrupted, continuous insulation.

The vertical light broom finishing on the walls also helped fast track the application of the home's stucco exterior. The wall finish served as an excellent substrate, making wall preparation unnecessary.

PRECAST FOR WORRY-FREE LIVING

While a home constructed from precast typically costs more up front, the savings over time more than make up for it.

The Faichtyger's precast home is virtually fireproof and moisture- and vermin-resistant. That means potentially lower insurance and no regularly scheduled pest control visits. In addition, continuous insulation on the wall and floor systems minimizes sound transmission and increases thermal efficiencies.

"The HVAC system can be downsized because the home is that much more air-tight and highly insulated," Talalaj said. "The air condition system was reduced from two units to one unit on a split system."

Finally, the home is built to last with minimal maintenance required over the years.

"That house will probably be around 200 years from now," Pedersen said. "If you can build a home out of concrete and do it right – pay attention to the details – precast is the perfect material."

PRECAST: A NATURAL FOR TINY HOMES

Precast is making big inroads in the tiny home market as well – a niche product that's attractive to people who favor a simpler, downsized lifestyle. Tiny homes are also popular with people who no longer want the house payments, insurance requirements,

A precast concrete tiny house offers the same benefits of a full-size precast house on a smaller scale.

taxes and upkeep of a larger home. In addition, a tiny house can be used for other applications such as a side business, an in-law suite or a space for animals.

Todd Sternfeld, CEO of Superior Concrete Products, based in Euless, Texas, began watching the tiny home trend years ago. In 2016, after winning a Creative Use of Precast award from NPCA for its Cleburne Ranchette model, the company began marketing a line of tiny homes.

"Sometimes you just have to go for it," Sternfeld said. "You have to learn as you go and make adjustments and changes and raise the bar as you go through the process. That's what we've done."

The phone has been ringing off the hook ever since.

A PLETHORA OF DESIGN OPTIONS

The 600-square-foot, two-bedroom, full-bath Cleburne Ranchette, with two additional outdoor living spaces, is the company's most popular model.

Superior fabricated the model using in-house design and labor and based it on existing products.

"It was an easy transformation," Sternfeld said.

One of the biggest design advantages precast offers tiny homes is the large variety of available textures and colors. Superior offers wood, brick, stone and stucco patterns. This makes customizing the basic model easy.

"What we're finding is that everybody wants something a little different," Sternfeld said.

QUICK INSTALLATION

The steel-reinforced, modular precast wall panels provide a speedy and easy installation. It takes about two weeks to pour the foundation, anchor it with posts and erect the exterior walls, which serve as the frame for the home. The panels are already finished, so there's no need to paint or apply siding.

Another advantage of a precast tiny house is the available foundation options. A precast tiny house can be built on a conventional foundation, constructed on a steel frame for periodic relocation or put on wheels for a mobile lifestyle.

Owners of precast tiny homes also enjoy all the advantages of regular-sized precast homes. Like a full-sized precast house, precast tiny homes are water- and vermin-resistant, require little maintenance, and are fireproof and practically soundproof. In the future, Superior is looking to use precast for more than the walls.

"We're looking into building the tiny houses on a foundation in the factory setting and then bringing them to the site," Sternfeld said.

MANY ADVANTAGES

The durability and stability of precast products are the strongest drivers for homeowners who want protection from extreme weather. Wood-framed homes can't provide the same level of protection. And then there's the chameleon-like quality precast possesses. It can emulate countless building materials and finishes that can be mixed and matched to create endless possibilities.

The benefits precast offers contractors, designers and homeowners are slowly becoming common knowledge. Each successful installation, happy contractor and pleased homeowner spreads the word and pushes the industry toward a tipping point when it will become common practice to see precast elements in residential construction. PS

Shari Held is an Indianapolis, Ind.-based freelance writer who has covered the construction industry for more than 10 years.

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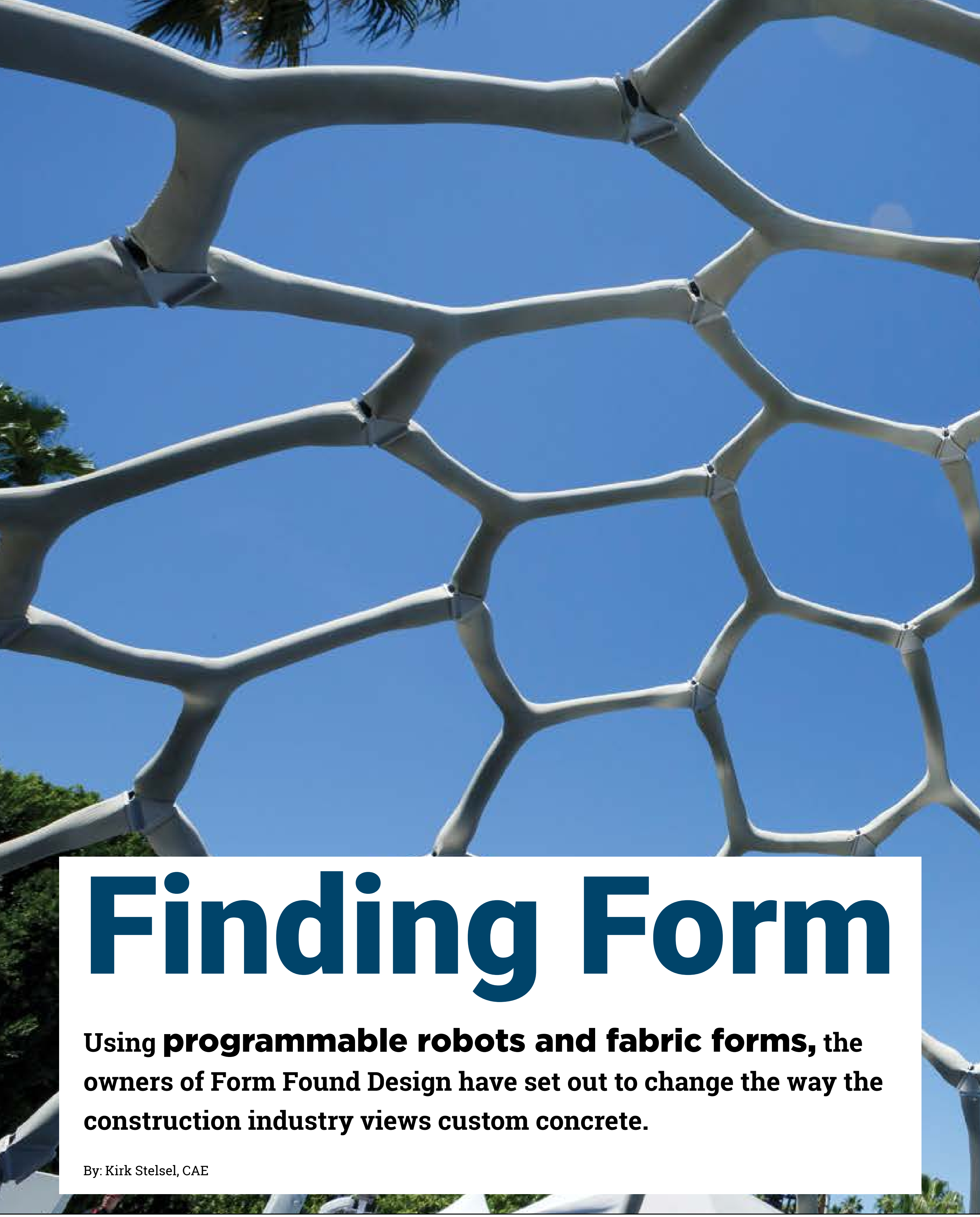
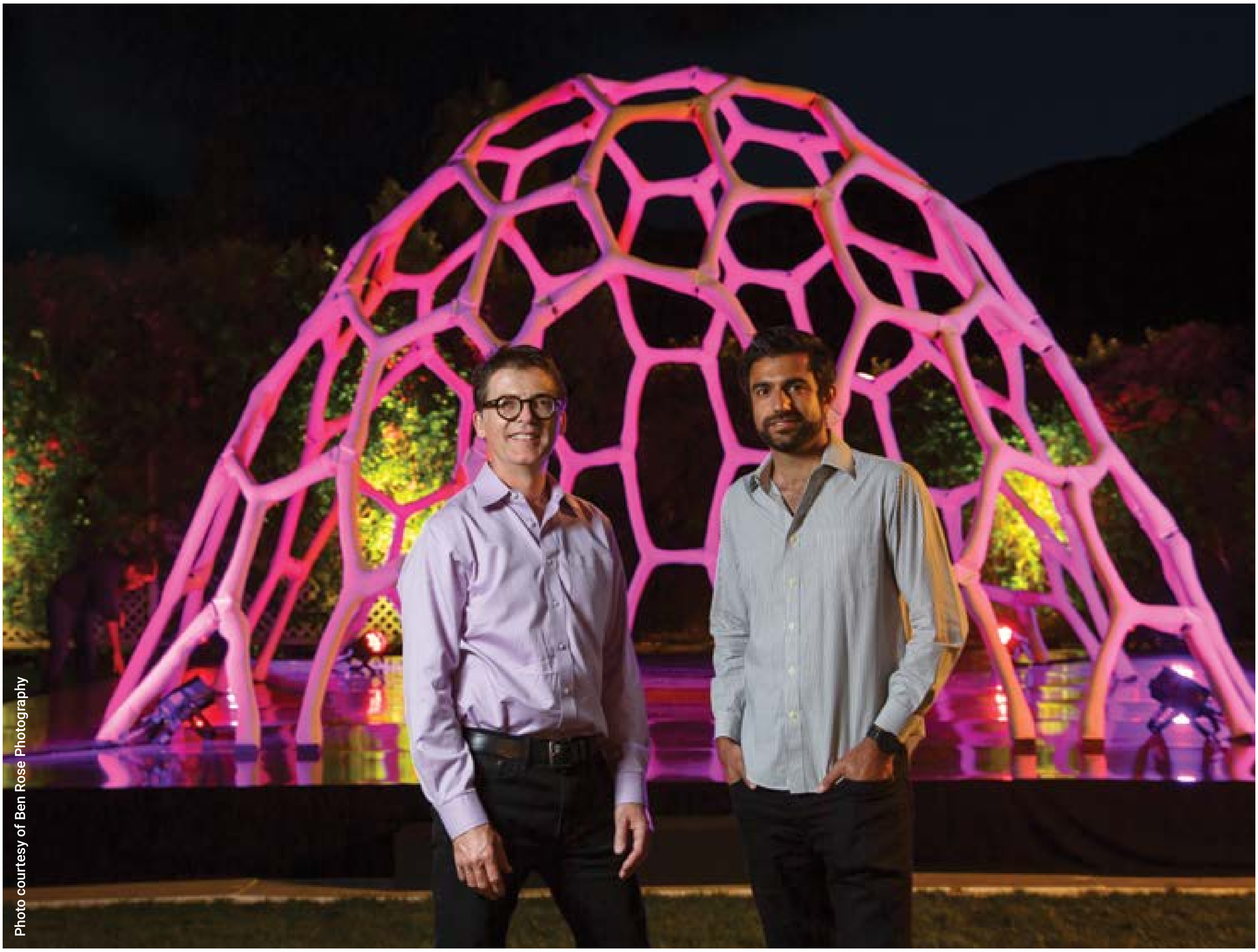


Finding Form

Using programmable robots and fabric forms, the owners of Form Found Design have set out to change the way the construction industry views custom concrete.

By: Kirk Stelsel, CAE

Photo courtesy of Ben Rose Photography



Ron Culver, AIA, and Joseph Sarafian, Assoc. AIA, LEED GA, used programmable robots and fabric forms to create the MARS Pavilion.

When Jeff Bezos – the man who disrupted the shopping industry with Amazon and spends $1 billion a year on his Blue Origin project – stopped to admire a freestanding precast concrete structure known as the MARS Pavilion, he told one of the designers, “That pavilion, it’s insane and insane is the best compliment I can give.”

What about this concrete structure caught the fancy of the richest man in the world? The structure itself is only part of the answer. The story behind its fabrication is much more complex, and therein lies the odyssey of two entrepreneurs who set out to reinvent custom precast concrete.

CHAPTER 1: AN IDEA TAKES SHAPE

Inspiration often strikes fast. For Ron Culver, AIA, and Joseph Sarafian, Assoc. AIA, LEED GA, it came at a technology seminar while pursuing their Master of Architecture degrees at UCLA. The two began to wonder how they could use programmable robots in tandem with fabric forms to create unique concrete shapes. Individuals like Mark West and Andrew Kudless, leaders in fabric-formed concrete, inspired their direction. With their plan in mind, Culver and Sarafian created Form Found Design and set out to realize their vision.

“Our intention is to change the paradigm for concrete casting in the architecture and construction industry,” Culver said. “We looked at a number of different ways to create adjustable forms but we arrived at this because we thought robotics would allow us to go from digital to physical in a way that isn’t being done yet. It’s demountable, reconfigurable, low weight, rapidly customizable and able to manage complex geometry without complex formwork, so it’s a very low cost to create mass customization.”

The two had to overcome many early challenges, such as how to connect the fabric to the robots, accurately position points in space to suspend the fabric, connect the pieces and reinforce the concrete.

They conducted early experiments with glass-fiber reinforcing, but as the duo scaled up they realized they needed something else in order to create a self-supporting structure. Traditional reinforcement wasn’t feasible for the shapes, which led them to

Connecting the fabric to the robots was one of the early challenges the team undertook.

use Helix Steel's Twisted Steel Micro Rebar.

During the research and development process, the two gave a talk in Sydney, Australia, in front of others experimenting in the robotics niche of architecture. There, they met Steve Fuchs, who had experience using robotics and high-end digital software for world-famous architect Frank Gehry's office. Fuchs soon became a part of the team, along with interns Andrew Lindauer from Orange Coast College in Costa Mesa, Calif., and David Spiva from Cal Poly in San Luis Obispo, Calif.

CHAPTER 2: AMAZON COMES CALLING

As the team's work progressed, it gained the interest of influential people, including representatives connected to Bezos. Each year, he convenes a conference in Palm Springs, Calif., named MARS for machine learning, home automation, robotics and space exploration. The invite-only event features cutting-edge technology, so the world's first robotically-cast concrete pavilion fit in well.

"Amazon taps some of the most provocative emerging

Photo courtesy of Form Found Design

technologies and brings them together to inspire each other for one exciting weekend," Sarafian said. "They brought us on and asked how big we could go with our technology. We sent them a few renderings showing a 6-foot-tall structure and they wanted to go bigger and have a large impact on the conference."

After scaling up to 14 feet tall, the team realized they needed to call in engineering reinforcements. Steve Lewis, Ph.D., P.E., FRSA; Kais Al Rawi, JEA; and Cheryl Luo of Walter P. Moore Engineering came on board for the project and the team began to look at geometries that would take advantage of the inherent strengths of concrete, primarily its compressive strength properties.

Using a Rhino 3-D model and gravity simulator software Kangaroo3D, the team landed on a catenary structure based on the way gravity affects fabric hung from four points. In the dome-shaped design, nearly every element was in compression. Before construction, Lewis and the engineers at Walter P. Moore analyzed the structure using finite element program Strand 7 to rationalize the elements in 3-D and determine the stresses and forces on each.

"We had a good form in that it was optimized to carry axial compressive loads, so we took the design model, which is more about geometry, and revised it," Lewis said. "First, we had to create a rationalized mesh geometry that we would be able to use in the program and then we had to come up with a digital workflow where we could iterate through different design models and ensure we could connect the wishbone elements together. At WPM, we embrace the philosophy of digital workflow where we strive to embrace digital technology as a means to facilitate meaningful collaboration with our clients."

"The analysis model we did was really high-fidelity," Sarafian added. "It had almost 600,000 elements. Instead of looking at the whole pavilion as an entire structure and analyzing the loads acting on it all at once, finite element analysis is basically treating each component like its own building."

Using this analysis, the team assigned loads and looked at the stresses on the elements, how they deflected and how the structure would perform. In instances where the stresses were too high, Lewis communicated with Culver and Sarafian and suggested options such as increasing the cross-sectional diameter or refining the design to add more wishbone elements.

"The ability to generate a high-fidelity digital analysis model where the local stress could be boiled down to two numbers of principal stress of compression and tension was essential as the structure had no distinct load path that described not just gravity or vertical loads, but also lateral loads," Lewis said.

Without the integrated, high-fidelity digital workflow, the engineering team likely would have needed to simplify the structure in order to understand its structural behavior and feel comfortable with its strength and stability. Such an approach would have compromised the aesthetic vision and also potentially led to a less-than-optimal, heavy structure.

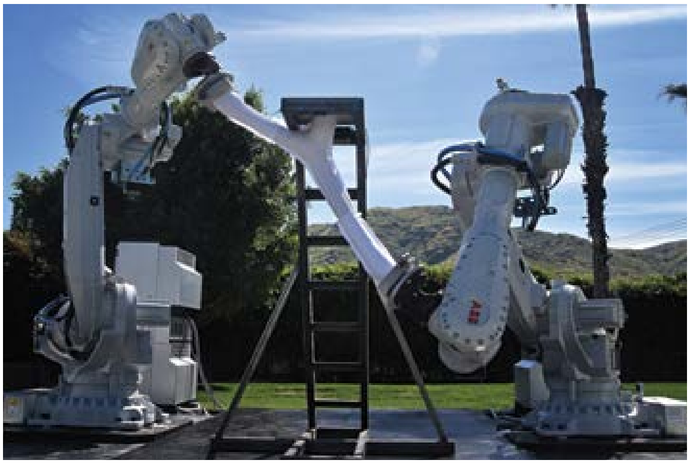
In addition, although a temporary structure, it was located in a seismic zone and consideration of lateral seismic loads was required. This revealed more significant tensile load paths that had to be considered. The assessment included not only the concrete elements, but also how the load was transferred locally at the node anchor embed. Iterations were needed to optimize the connection locally to increase the pullout capacity of the connection. The digital analysis model allowed the team to obtain the pullout demands efficiently.

CHAPTER 3: SHOWTIME

After months of R&D, the team anxiously started casting the elements for the pavilion. First, they made sure they had the process set up precisely and that the robots were accurately calibrated. They spent a lot of time establishing tolerances and ensuring every last aspect was accurate. That work paid dividends. Production ran smoothly with very few issues.

"The first month was really just troubleshooting and creating a system that had never really been built out before," Sarafian said. "Early on, we were casting one per day and by the end we were casting about eight per day."

At the MARS conference, they assembled the 70 unique



Photos courtesy of Form Found Design

On-site at the MARS conference, attendees were able to see how the elements were created and view the concrete and connections up close.

elements over the course of three days with precision levels of 1/16 of an inch. The final structure was not only self-supporting, but structurally redundant. Any element could fail and the surrounding elements would assume the additional loads imposed. The team was proud of the fact that although it was the first of its kind, the project came in on time and on budget. Just six months prior, the project was only renderings. Now, their structure was ready to be seen.

"It was a testament to the team and how hard we were willing to work," Sarafian said. "I've never worked harder in my life, and our engineering team worked tirelessly to meet our demanding schedule and unique project goals. It was a lesson for us in learning how to be relentless."

CHAPTER 4: THE FUTURE

After premiering at the MARS conference, the pavilion was sent to the A+D Museum in Downtown Los Angeles as a temporary exhibit. It has now been disassembled and the team is focusing on how their innovative system can be used in real-world applications.

After the initial publication of the project, two major architecture firms reached out to Form Found Design to ask for product information. This was the validation the team needed.

"There are firms out there that see this as a solution to something they are designing," Sarafian said. "The idea is we can build this out as a facade system that could introduce variation without the added cost of variation. We would like to roll out a system and web app that would allow a user to toggle certain presets and design their own facade with our product."

They are currently gearing up to build the first prototype of a facade system they aim to complete by December 2018. It will be similar to past work, but robust enough to take on all the new challenges of scale.

To tackle this next hurdle, they will rely on mentors like Ken Vallens of CTS Rapid Set and Luke Pinkerton of Helix Steel to take on the challenges of commercialization. Just as they focused on preparation before casting the MARS Pavilion elements, they are proceeding deliberately as they know their early decisions will dramatically affect their success down the road.

There is a lot of work left to be done, but the Form Found Design team embraces the process. If their ability to overcome challenges and catch the eye of Bezos and major architecture firms is any indication, they are up to the task. PS

Kirk Stelsel, CAE, is NPCA's director of communication.


NPCA file photo

Taking Comfort in Precast

Keep comfort in, moisture out and energy bills low with precast concrete building enclosures.

By Claude Goguen, P.E., LEED AP

Insulated wall panels create an ideal building envelope that provides high R-values while regulating temperature fluctuations.

We spend a lot of time in buildings. The Environmental Protection Agency estimates more than 90% of the average day is spent indoors.[1] Most of us wake up in a building and go to other buildings for work, school or shopping. We continue in and out of buildings all day long, never stopping to contemplate the comfort provided by building enclosures.

These partitions provide an efficient barrier between the serene and comfortable inside and the sometimes chaotic and inclement outside. Building enclosures are designed to be aesthetically pleasing while providing security, safety and comfort to occupants. That includes keeping moisture out and possessing thermal properties that help maintain a comfortable climate inside regardless of conditions outside. That can be a tall order depending on climate, location, orientation and other factors.

As the green building trend continues to grow, the methods and materials used to manufacture these building enclosures have become a primary aspect of energy-efficient design. Romans long ago recognized concrete as an excellent building material not only for its durability, but also for its ability to absorb, store and release ambient heat to even out interior temperatures. Thousands of years later, for these same reasons and more, concrete continues to be a primary material for building construction in today's age of sustainable building.

PRECAST WALL TYPES

There are myriad precast wall systems in North America, but most of the them fall into three main categories: solid wall, thin wall or sandwich panels. They can be an architectural veneer, a structural wall or a combination of both. They can also be conventionally reinforced or prestressed and come in a wide variety of finishes and colors.

Solid walls are simply wall sections of solid concrete and reinforcing. Thin wall panels are thinner sections with a framing system attached. These are often used for veneers and can be attached to a concrete or steel structural system. Some of these thin wall panels will have insulation installed at the manufacturing facility so utilities can begin work on-site immediately.

The sandwich panel, or insulated precast concrete wall panel, has two layers of concrete separated by a layer of rigid insulation. Wythe connectors are installed so that they connect both layers of concrete through the rigid insulation. This helps ensure all layers will act as a monolithic system when exposed to loads. Concrete wythes can vary in thickness depending on the structural and architectural requirements of the project. Typical wythe thicknesses range from 2 inches to 6 inches. Wythe connector materials include carbon steel, carbon fiber and plastic.

Each type of wall section will perform differently. However, they are all precast concrete which means they possess inherent qualities when it comes to thermal- and moisture-related characteristics.

Thermal Mass

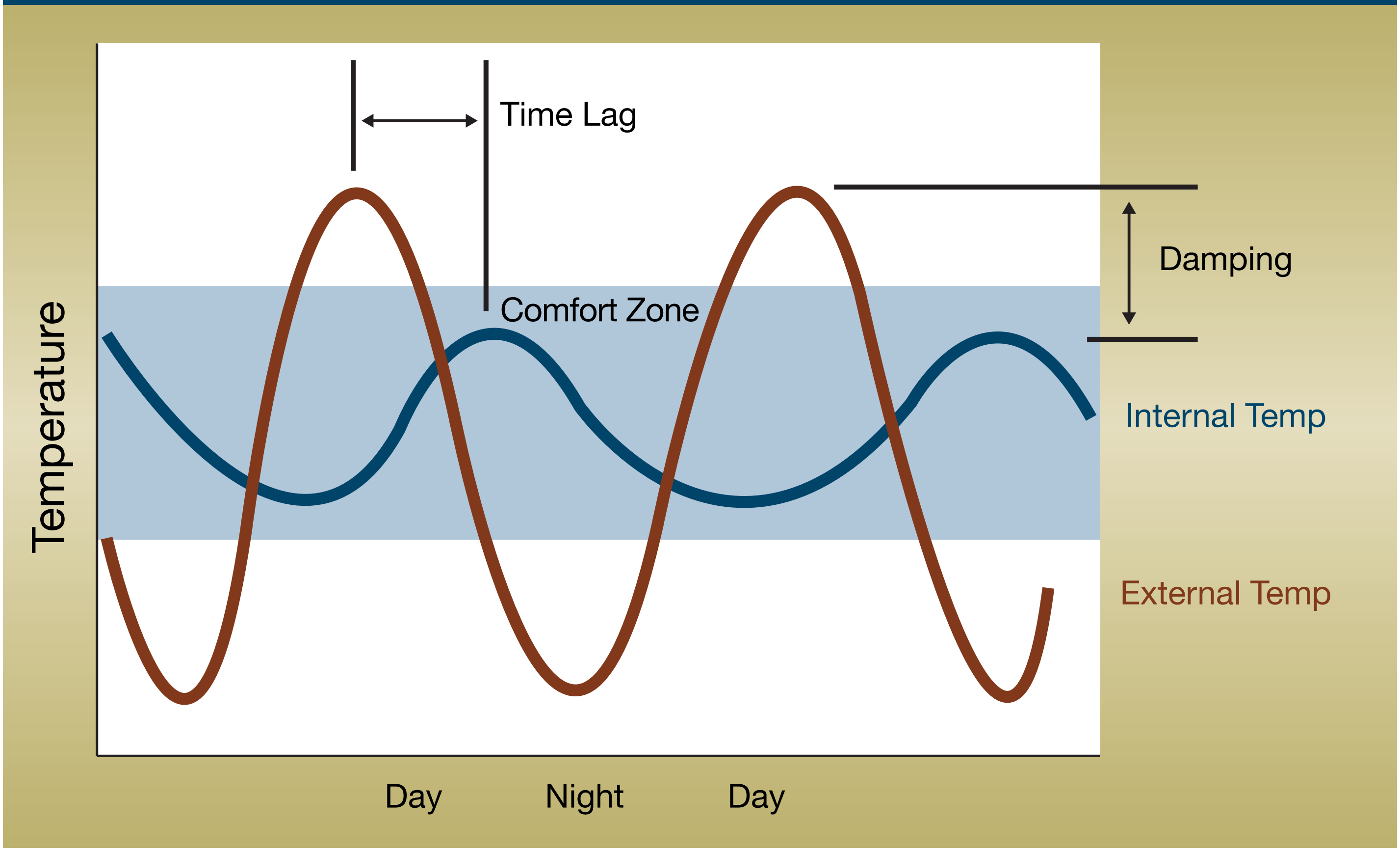


Figure 1 – Thermal mass of concrete

THERMAL MASS AND CONCRETE

Concrete is a dense material. This density, along with concrete's specific heat, gives it a high thermal mass. Thermal mass is defined as a material's ability to store heat energy. Precast concrete walls and roofs absorb heat, keeping the interior of a building cooler throughout the day. That heat is then released at night when temperatures are cooler. Think of it as a thermal battery that recharges every day and releases at night (see Figure 1). Also, thermal mass on the interior building surface will help absorb heat gains in the interior space. Thermal mass is useful, especially in areas with higher differences in daytime and nighttime temperatures, to dampen the fluctuations of indoor temperatures. This results in a lower demand on HVAC systems and consequently can save money on equipment and energy bills.

INSULATION AND CONCRETE

While precast concrete excels in thermal mass, it is less effective as an insulator. A material's ability to have insulative qualities depend on its thermal resistance, or its ability to resist heat flow.

We measure this as R-value. Precast concrete has low R-values which vary based on the concrete's density. For a concrete density of 150 pounds per cubic foot, the R-value is approximately 0.7 per inch. As concrete density decreases, the R-value increases. However, if rigid insulation is added, these numbers go up dramatically. The types of rigid insulation generally used with precast concrete wall panels are:

- Expanded Polystyrene: R-values typically 3.8-to-4.4 per inch
- Extruded Polystyrene: R-values typically around 5 per inch
- Polyisocyanurate: R-values typically 6-to-8 per inch

A precast concrete building is good at regulating its own temperature. When rigid insulation is added to precast panels, such as sandwich panels or thin wall panels, it creates an ideal building envelope that provides high R-values while regulating temperature fluctuations.

American Society of Heating, Refrigerating and Air Conditioning Engineers Standard 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings," is an international standard that provides minimum requirements for energy-efficient designs for buildings. The standard acknowledges the benefits of concrete walls.[2]

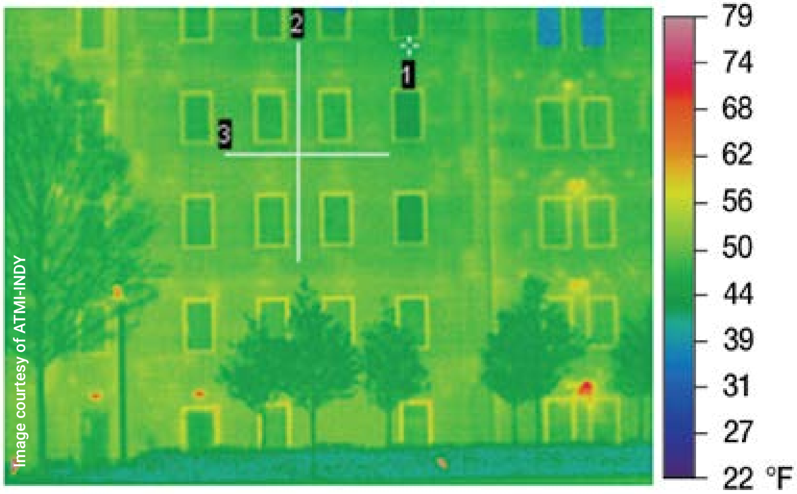


Figure 2 – In this thermal image of a precast building, the only hot spots are exterior lights.

WATCHING FOR THERMAL BRIDGES

Precast concrete thermal properties will remain constant if the section characteristics are constant. Thermal bridging refers to areas in the precast concrete section where the effective thermal R-value is reduced due to a change in section. This could be because of a gap in insulation due to a stud or wythe connector. This can be minimized by using continuous insulation and, when necessary, low conductivity wythe connectors.

Thermal imaging (see Figure 2) is a useful tool for evaluating the performance of building enclosures. A well-constructed precast concrete building will show very few signs of thermal bridging.

MOISTURE MANAGEMENT

The infiltration of moisture into a finished building is one of the biggest challenges. Some wall assemblies incorporate many layers of different materials, including an air gap where a leak can form or condensation can take place. Moisture forming on the interior of a building is unsightly and can cause damage to the building and its contents, with the damage sometimes hidden from view for extended periods of time. Moisture accumulation can cause mold to form, wood to rot and metal to corrode. These are three things precast concrete won't do. Mold needs certain conditions to grow and since precast concrete is inorganic, it will not enable mold to form and grow like it does on wood and Sheetrock. Precast concrete will not rot or corrode in the presence of moisture, but this may be a moot point since moisture is less likely to be present with precast concrete enclosure systems.

Precast concrete's permeability, or the speed at which liquids and gases can penetrate it, depends primarily on its porosity. The porosity of concrete is a function of the quality of the mix and the manufacturing and curing process. Since precast concrete is manufactured in a controlled environment, quality control is enhanced and porosity is minimized, making the wall virtually impenetrable by moisture.

The key to managing moisture on a building project is to get it enclosed quickly. Precast concrete enclosures can be erected rapidly, reducing the exposure of the building's interior to humidity and moisture. Also, precast wall assemblies are panelized, which means fewer joints than other types of enclosures. This means less points of potential moisture penetration.

LASTING BENEFITS

The construction team will benefit from certain attributes of precast concrete building enclosure systems such as ease of installation. Following construction, air quality, comfort and energy efficiency are benefits occupants and owners of precast concrete buildings get to enjoy. Add in the inherent durability and resiliency of precast and all will enjoy a quality precast concrete enclosure for decades to come. **PS**

Claude Goguen, P.E., LEED AP, is NPCA's director of sustainability and technical education.

References:

1. U.S. Environmental Protection Agency. 1989. Report to Congress on indoor air quality: Volume 2. EPA/400/1-89/001C. Washington, DC.
2. ASHRAE 90.1 - 2016, Energy Standard for Buildings Except Low-Rise Residential Buildings, 2016. Atlanta, GA

Specifier Q&A

This issue, Precast Solutions magazine sits down with Morris Adjmi Architects to discuss the company's involvement with precast concrete products and projects.

Company: Morris Adjmi Architects

Q: What is your field of focus?

A: Morris Adjmi Architects interprets the historic forces that shape our cities to design buildings that are both contextual and contemporary. Our diverse team of architects and interior designers is guided by a shared belief that timeless ideas about beauty and harmony can be integrated into the modern built environment, but the expression of those ideas must reflect the way we live today. We are a leader in the revitalization of post-industrial neighborhoods and historic districts with commercial, residential and cultural projects that are imbued with a distinct sense of place and purpose.

Q: What are the benefits of using precast concrete products?

A: The benefits are the ability to create interesting shapes, the speed in process and the lower cost is also a helpful factor.

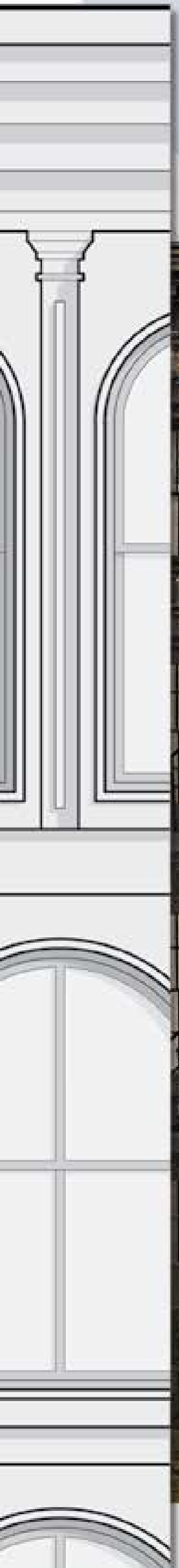


Photo courtesy of Morris Adjmi Architects

The 83 Walker building in the Tribeca East Historic District of New York City features a concrete facade.

A facade of terracotta arches created by precast panels grace the 408 Greenwich building in NYC.

Q: What are some unique or interesting projects on which you specified precast concrete?

A: The nine-story 83 Walker in the Tribeca East Historic District of New York City features a concrete facade that reflects the historic architectural processes that have shaped New York while taking inspiration from contemporary artist Rachel Whiteread.

Our 1100 Ludlow building in downtown Philadelphia includes a glass and precast facade and factory-style windows that revitalized the existing building with plenty of additional light and air.

And, 408 Greenwich in NYC has a facade of terracotta arches created by precast panels that make the mixed-use building a modern interpretation of the traditional masonry buildings found throughout the Tribeca North Historic District.

The 1100 Ludlow building in downtown Philadelphia includes a glass and precast facade and factory-style windows.

Q: How have you seen precast concrete evolve? How do you see it continuing to impact your work?

A: It has gone from a mostly utilitarian material into varied, higher design. We will continue to push the limits of plasticity. **PS**

Photo courtesy of Precast Concrete Association Australia

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