

# precast solutions

A Magazine for Specifiers and Engineers

SPRING 2013

ARCHITECTURAL

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How to Rebuild After Superstorm Sandy

Creative Use of Precast Awards

Recent Advancements in Fabric Forms

Perot Museum

Retail Projects Need Quick Enclosure



## PRECAST CONCRETE VENEERS



## BEAUTY WITH BENEFITS

Look closely. There's no longer a need for materials that are heavy, expensive, not reproducible, and require expensive maintenance. Precast concrete veneer replaces those hard-to-work-with materials without the difficulties, environmental impacts or other associated concerns. It's the beauty of old-world stone with all the modern benefits.

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ARCHITECTURAL ISSUE

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A strong, safe and resilient precast concrete enclosure for this home in Lincroft, N.J., was erected faster than homes built with traditional construction materials. In addition to its superior resistance to storm forces and water penetration, precast concrete offers the homeowner elegant architectural elements, energy savings and a very quiet interior.

[www.northeastprecast.com](http://www.northeastprecast.com)

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 **NPCA**  
Precast ... The Concrete Solution

# NPCA

# CREATIVE USE OF

The National Precast Concrete Association's Creative Use of Precast Awards competition recognizes innovative applications of precast concrete in two categories: Above-Ground and Underground. An independent panel of industry experts served as judges, and awards were presented during The Precast Show 2013 in Indianapolis. For complete descriptions of this year's winning projects, please visit [precast.org/awards](http://precast.org/awards).



## ABOVE-GROUND CATEGORY

### FIRST PLACE

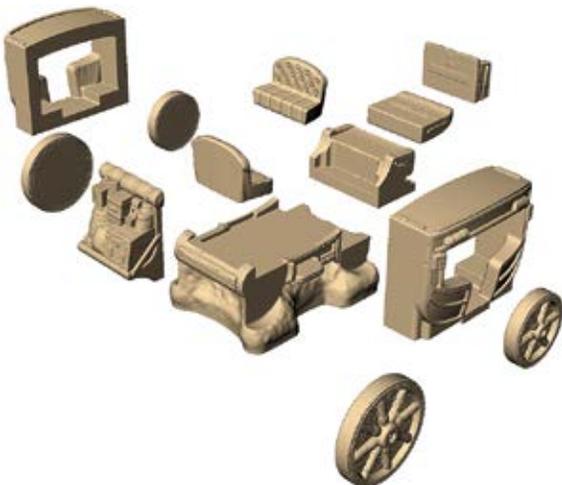
**Universal Precast Concrete Inc.**

([www.universalprecast.com](http://www.universalprecast.com))

**Project:** Stagecoach Climber

**Location:** Yucca Valley, Calif.

The challenge was to produce a realistic, fun-for-kids playground piece while staying within budget constraints, and Universal Precast Concrete met the challenge with a 13-piece, exquisitely detailed precast concrete stagecoach. The realism attained through the intricate design and painting of each piece adds to the authenticity of the replica, which serves as a focal point for the park and an indestructible climbing piece for kids.



# PRECAST AWARDS



## SECOND PLACE

**StructureCast** ([www.structurecast.com](http://www.structurecast.com))

**Project:** Madina Center

**Location:** Stockton, Calif.

When the project architect set out to design The Madina Center, a new Islamic worship center, he had a specific vision that would bring to life the center's mission and culture. To achieve this look in an efficient and cost-effective manner required a building material that could minimize the project timeline while also providing maximum design potential. The precast concrete solution created by StructureCast included a contract to manufacture and install 56 architectural precast concrete panels. The precast option trimmed the original construction schedule by 15 days, and the panels elegantly captured the architect's vision.



## THIRD PLACE

**StructureCast** ([www.structurecast.com](http://www.structurecast.com))

**Project:** Tejon Ranch Monument Sign

**Location:** Tejon Ranch, Calif.

As the second-largest contiguous ranch in the United States, the Tejon Ranch Co. controls more than 270,000 acres. A company that controls so much land needs an impressive sign, and a precast-and-stone design provided the perfect solution. The sign was manufactured in four hefty pieces, with the precast elements ranging from 12,000 lbs to 32,000 lbs. This design not only created an aesthetically pleasing result, but also provided a cost benefit and schedule savings and allowed for a small installation footprint in an environmentally sensitive job site.



## HONORABLE MENTION

**Northeast Precast LLC** ([www.northeastprecast.com](http://www.northeastprecast.com))

**Project:** Quarry Retaining Wall

**Location:** Millville, N.J.



**Pacific Precast Inc.** ([www.precastrail.com](http://www.precastrail.com))

**Project:** Martin Luther King Viaduct

**Location:** Portland, Ore.



## UNDERGROUND CATEGORY

### FIRST PLACE

**Oldcastle Precast-Lebanon**

([www.oldcastleprecast.com](http://www.oldcastleprecast.com))

**Project:** Bellamy Bat Cave

**Location:** Clarksville, Tenn.



With a lethal fungus known as “white nose syndrome” devastating the bat population on the East Coast, the local nature conservancy turned to a precast concrete solution to combat the spread of the deadly disease. The conservancy worked with the Oldcastle Precast plant in Lebanon, Tenn., to craft a bat cave from 28 box culvert sections. The interior top sections were cast with a form liner to mimic a natural limestone cave, and other modifications provided access for researchers and natural separations for bat species. “Precast concrete gave us the best shot at getting this project done quickly and economically, and time is of the essence when you are talking about conservation,” said the owner. The project was featured in 2012 in the New York Times and on PopularScience.com.



## SECOND PLACE

**Cape Fear Precast LLC**

**Project:** Precast Concrete Stormwater Wetland

**Location:** New Bern, N.C.

In the city of New Bern, N.C., a proposed wetland initiative with the NC Ecosystem Enhancement Program (EEP) and the NC Clean Water Management Trust Fund was realized, thanks to precast concrete from Cape Fear Precast. The precast stormwater wetland captures and treats runoff from a large watershed and can treat runoff from more than 1,000 acres of residential and commercial property. The project is unique in both its size and scope, and it is one of the largest stormwater retrofits built to date in the state. The outlet weir for the project is modeled after a labyrinth weir design concept. The "W" shape creates more flow length in a smaller width than traditional spillways. The design also incorporates flashboard risers that provide flexibility for controlling water levels in the wetland.



## HONORABLE MENTION

**Terre Hill Concrete Products Inc.** ([www.terrehill.com](http://www.terrehill.com))

**Project:** World Trade Center Transportation Hub Stormwater Filtration System

**Location:** New York, N.Y. **PS**



## THIRD PLACE

**By-Crete** ([www.bycrete.com](http://www.bycrete.com))

**Project:** Pegula Ice Arena

**Location:** University Park, Pa.

The Pegula Ice Arena project included an underground water detention system designed to control runoff mainly from the new arena. This project consisted of 252 pieces of box culvert. The finished system had to be watertight to prevent any sinkholes from forming in the area. Pieces were delivered just-in-time for installation. Three rows of box culverts were installed at a time as the excavation company prepared for the next three rows. This method shortened installation time to less than two months, saving on labor costs and allowing the roads and pathways to stay open for as long as possible. By building the system out of precast concrete, the contractor was able to create a 15-20% cost savings in comparison to pouring in place.



**BREAKING THE MOLD:**

# EXPLORATIONS SHAPING ARCHITECTURAL PRECAST

**RECENT INNOVATIONS IN ENERGY EFFICIENCIES AND ASSEMBLY TECHNIQUES FOR PRECAST CONCRETE BUILDING ENVELOPES OPEN THE DOOR TO UNIMAGINED ARCHITECTURAL AND SUSTAINABLE DESIGNS.**

By Matt Roper, M.Arch., LEED AP BD+C

  
*Full-scale thin-shell wall panel made by spraying fiber-reinforced concrete on a hanging geotextile sheet at the Lafarge precast factory, Winnipeg, Manitoba.*  
Photo courtesy of CAST, University of Manitoba

**T**he influence of concrete on the modern world cannot be understated. It has formed, shaped and progressed our built environment. Its solidity, strength and durability have advanced its prevalence in the building sector.

Precast concrete in particular has advanced modern civil, structural and architectural design. It has been used in some of the world's most iconic structures, borne of

advancements and refinements in material properties and assembly techniques.

While precast concrete has afforded our society functional advancements, its primary use has often been underappreciated as the foundations of our cities' hidden infrastructure networks and buildings, structural systems. However, what was once viewed as a mundane industrial material is now developed and



refined to reflect a sustainable, flexible and responsive product demanded by today's economies, societies and environment.

Now more than ever, construction projects are demanding efficiencies in both invested time and materials. Precast concrete innovations offer economic, environmental and aesthetic solutions. Advancements in admixtures, panel system assemblies and formwork techniques have all contributed to the revival of architectural precast in modern building design. In many cases, these advancements were explored, refined and reinvented in the form of both conventionally and prototypically built projects.

### **SUPERIOR SUSTAINABILITY WITH INSULATED PRECAST PANELS**

Insulated precast panels have presented designers with integrated building envelope and cladding systems that offer advantages in continuous air/vapor barriers, superior lifespan and reduced construction schedules. The article "Precast Insulated Wall Panels: Get the Whole Package!" (Summer 2012 *Precast Solutions*) offered a holistic overview of product configurations and their benefits, and nowhere have the advantages of this method of construction been pushed further than the Habitat for Humanity Net-Zero Prototype in Edmonton, Alberta (see "Precast Concrete Can Be



*(left)*  
Full-scale fabric-cast concrete panels designed and built by architecture student Mike Monette at the Lafarge precast factory, Winnipeg, Manitoba.  
Photo courtesy of CAST, University of Manitoba

*(right)*  
Energy-efficient panels with continuous insulated R-40 insulation arrive on site painted with windows installed and ready to be lifted into place.  
Photo courtesy of Habitat for Humanity Edmonton



*(left) Fabric formwork for a 16.5-ft variable section T-beam constructed by Ronnie Araya, architect.*

*(middle) Prototype formwork rig for the 39.4-ft beam.*

*(right) Volume of variable-section bending moment-shaped beam visually compared with a conventional rectangular beam of the same major dimensions.*

Photos courtesy of CAST, University of Manitoba

Habitat Forming,” Fall 2012 *Precast Solutions*).

High-performance insulated precast concrete panels were used to construct the exterior envelope, which when fully assembled created a superior level of thermal performance. The 8-in. layer of expanded polystyrene between the interior and exterior precast concrete wythes produced a continuous insulation barrier with an exceptional R-Value of 40.

The inherent strength and thermal mass of the precast concrete structure has lent itself to the integration of numerous other sustainable initiatives that will ultimately allow the home to achieve its net-zero status.<sup>1</sup> For example, the high insulating value and thermal capacity of the panels help normalize the fluctuations of warm and cool cycles, while a geothermal system that feeds hydronic heating and cooling through the structure’s interior can minimize or even offset any heating and cooling requirements.

The hollowcore roof structure also provided opportunities for the mounting of photovoltaic cells as well as vegetation to further contribute to the home’s sustainable features. The solar cells feed into the home, or back into the electrical grid if surplus energy is produced while surplus rainwater is collected and fed through additional planters incorporated in the exterior panels, allowing the ground nativescaping to climb up the structure to form exterior green walls.

Precast insulated panels provided the vehicle in which the Habitat for Humanity net-zero prototype was explored, with intentions of supplying a social, innovative and affordable housing option for both new and in-fill

developments. While the system proved to offer incredible benefits in achieving the sustainable goals, additional work is required to economize the panels. In order to enhance the affordability of future structures, it became apparent that the number of unique panel types would either have to be reduced or, like childhood Erector and Lego sets, have to be assembled in multiple variations for various housing forms.

Methods of achieving this flexibility and adaptability while maintaining simple and efficient formwork may lie in the formwork itself.

## **FABRIC FORMWORK: FLUID POETIC POTENTIAL**

Concrete is a remarkably fluid material that can pick up detailed textures and impressions from its casting. In addition to the moldability of concrete, a variety of aggregates, concrete surface retarders and sandblasting techniques can achieve additional transformations of this highly adaptable material. Nowhere is this fluid nature of concrete being pushed more than at The Centre for Architectural Structures and Technology (CAST) at the University of Manitoba.

Using fabric formwork methods of casting, CAST and its founding director, Mark West, have made prototypes of precast concrete panels and other precast structural members including columns, beams and thin-shell vaults. Commonality in the work that has been produced at CAST includes “using simple construction methods and common building materials, new technologies become accessible to both high- and low-capital building cultures and economies.”

Fabric formwork allows for a much more dynamic and reactive resistance to the weight, shape and

<sup>1</sup> Net-zero is defined in this application as having a balanced energy usage/production over the course of a full year.



◀ Precast concrete is featured on the interior as well in the form of cantilevered precast stair treads. Photos courtesy of Ian Grant Photography

structural forces of the object being created. For the production of precast panels, rectangular polyethylene or polypropylene fabric sections are stretched or suspended from the panel framework, and are allowed to deflect under the weight of the concrete they contain.

Intermediate supports are then positioned under the suspended framework, which, when built-up layers of glass fiber-reinforced concrete are applied to the flexible fabric, will interact with the flexible surface producing a dynamic “direct-cast” mold for casting future panels. This efficiency in form means a significant reduction of material, time and labor in each element produced, as the casts are “defined by three-dimensional tension curves rather than planar surfaces.”<sup>2</sup> While the forms generated from these studies often hold extraordinary creative potential, the structural possibilities are just as great.

Further prototyping of this method of precast fabrication will continue to prove its value for greater integration into the construction industry. While standardization is often seen as the path to finding project economies, fabric formwork may serve as the basis for standard yet easily customized molds for structural and architectural precast panels.

## CASTING INNOVATIONS: UNLIMITED ARCHITECTURAL POSSIBILITIES

The ability to shape concrete as desired, supplemented by the economies, versatility and durability of precast panels, make it the preferred building material of today.

Both academic and industry innovations in precast concrete have revealed the potential and benefits this method of construction has to offer. An efficient building system must be multifaceted and the sustainability, durability and flexibility offered by precast panel systems are lending themselves to ever more economic and aesthetic solutions. The prototyping described demonstrates leading-edge research with the intention of learning through construction. As more data are collected and additional structures are monitored and measured, we will continue to see rapid and progressive refinement of this product. **ps**

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Matt Roper

<sup>2</sup> West, M. (2011) Prestressed Fabric Formworks for Precast Concrete Panels. Winnipeg, Manitoba



# TIME, MONEY AND PRECAST

**FASTER CONSTRUCTION WITH PRECAST CONCRETE EQUALS**

**MORE SALES FOR NATIONAL RETAILERS.**

By Carrie Johnson, P.E., and Doug Tayrien, AIA, LEED AP

Photos courtesy of SGA Design Group ([www.sgadesigngroup.com](http://www.sgadesigngroup.com))



savings can mean significant additional sales for a large retailer.

Our clients like to use structural insulated precast concrete panels, in part because of their speed of erection. The precast panels do not need structural steel columns at the perimeter or additional insulation to install, which means more exterior walls can be erected in less time. Construction time using precast structural panels can be months less than with CMUs (Concrete Masonry Units) and can also be significantly less than with site-cast concrete tilt-up walls if the precast panels are ordered early in the design/construction process. The goal is to have the panels installed immediately after the installation of the foundations. Having the building dried in<sup>1</sup> quickly means you can allow more trades on site installing more materials. This is particularly true in northern climates.



*Precast concrete Walmart Supercenter in Chester, S.D. Main shell building walls are integrally colored precast panels.*



*Quickly erected precast structural panels are shored and waiting for structural steel for roof.*

**W**hy would a national retailer consider using a precast concrete wall panel system over another exterior wall system? From our experience, it boils down to construction schedule and construction cost. Precast wall panels can be a very attractive design option for exterior walls. Yes, the quality and durability of the panels are important to a retailer, but the key deciding factors for using precast are reduced construction time and competitive costs compared with other exterior building wall systems.

### **RETAILER OPENS FOR BUSINESS SOONER**

Time really is money in retail construction. The faster a retail building is built, the faster a merchant can start selling products. Even a few weeks of construction time

### **FRIGID WEATHER NOT A PROBLEM**

A few years ago, we traveled with a client to look at some of their first precast projects in Minnesota and North Dakota. It was winter, 10 F, snowing, and a north wind was tearing across the northern plains. One of the projects was located just south of the Canadian border in North Dakota.

The project had started in the early fall, and by winter the precast panels were up and the building was dried in. Inside, four space heaters were warming 150,000 sq ft of space. The subcontractors were pouring concrete floor slabs, erecting interior walls, installing mechanical and electrical equipment – all while working without winter jackets. Fantastic! They were months ahead of schedule compared with a comparable CMU project.

<sup>1</sup> Dried in = enclosed and protected from the elements



Even in frigid weather, a subcontractor is comfortably working in short sleeves once the precast enclosure and roof are complete.

Retail representative, structural engineer and architect are inspecting precast in 10 F weather. Precast wall systems mean early completion of building enclosure.

This example shows why precast in northern climates is a great solution for winter construction.

But does precast make sense for southern climates? Yes, there can still be a time savings using precast versus CMUs and versus site-cast, tilt-up panels. Again, the key is to have panels on site and ready to install when the foundations are complete.

### COMPETITIVE COST AND COLUMN ELIMINATION

So why isn't every national retailer using precast? Cost can be a significant factor. Getting your retail store open earlier is desirable, but if the cost of the precast panels is more than CMU or tilt-up wall systems, it can eat into sales profits, and thus the benefits of a shortened construction schedule could be reduced or eliminated altogether.

While the initial cost of precast panels may be higher than tilt-up or CMU walls, a detailed cost comparison may reveal that precast construction compares favorably with the other methods.

Precast walls are most competitive on large one-story buildings with roof framing heights of 20 ft or

more. The large footprints make precast panels more competitive due to the increased number of repetitive panel sizes. The tall spaces are ideal for precast walls due to the elimination of perimeter columns and girders required with other wall types. This also provides a second advantage in that it allows for a larger uninterrupted space within which to merchandise.

Precast walls are also more competitive on buildings with large cantilevered parapets (distance from the top of the roof framing to the top of the wall). If the cantilever is more than 6 ft, wall systems like CMUs require an extensive amount of additional grout and reinforcing steel, while light-gauge systems require extensive back-up structural steel. Precast panels can be used for these spans with little or no additional reinforcing. More and more jurisdictions are requiring taller parapets to screen rooftop equipment. At the same time, recent codes have more than doubled the required design wind load on parapets. Structural precast panels are better able to handle these cantilevered loads.

The time savings can also be considered a cost benefit. A shortened construction schedule means a reduction in job-site overhead (salaries, trailer and



utilities) that results in significant savings.

A cost comparison should include both short-term and long-term cost savings. By using integrally colored concrete panels in lieu of painted CMUs, both the costs for initially painting and then repainting every few years will be reduced. The increased thermal mass of precast walls also reduces temperature swings, which can reduce heating and cooling costs. These maintenance cost reductions may make the life-cycle comparison of using precast walls competitive even if the initial costs are higher.

## CONCLUSION

There are a number of advantages that make precast walls an attractive alternative for retailers. In order for precast to be selected, it really needs to meet two needs:

reduction in construction time so that stores can open more quickly, and competitive pricing compared with other exterior wall systems. To get a retailer's attention, you need to be able to demonstrate satisfaction of both of these criteria. **PS**

*Carrie Johnson, Master of Architectural Engineering, P.E., is a principal of Wallace Engineering Structural Consultants Inc., Tulsa, Okla. She has 26 years of experience in structural engineering. Carrie has been on the board of directors for the National Council of Structural Engineers Association (NCSEA) for the past five years and is currently the vice president of the organization. [www.wallacesc.com](http://www.wallacesc.com)*

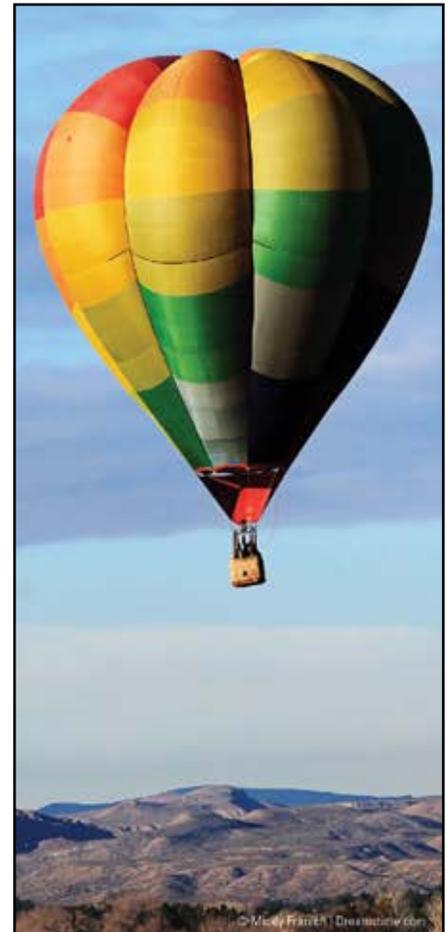


Carrie Johnson

*Douglas Tayrien, AIA, LEED AP, is a Principal with SGA Design Group. He has 29 years of experience in architecture and specializes in retail prototyping and design. Tayrien is a licensed architect in multiple states and a member of the American Institute of Architects. He is certified with the National Council of Architectural Registration Boards (NCARB) and is a LEED Accredited Professional. [www.sgadesigngroup.com](http://www.sgadesigngroup.com)*



Douglas Tayrien



## REACHING NEW HEIGHTS

The National Precast Concrete Association's Plant Certification Program has earned accreditation from the American National Standards Institute. ANSI accreditation signifies that NPCA's Plant Certification Program is consistently administered in accordance with international standards.

### NPCA Plant Certification

The largest, most comprehensive certification program for precast concrete on the planet.

**Visit [precast.org/certify](http://precast.org/certify)**  
**For more information on NPCA Plant Certification**





**SAFER & STRONGER:**

# HOW TO REBUILD A SUPERSTORM SAND

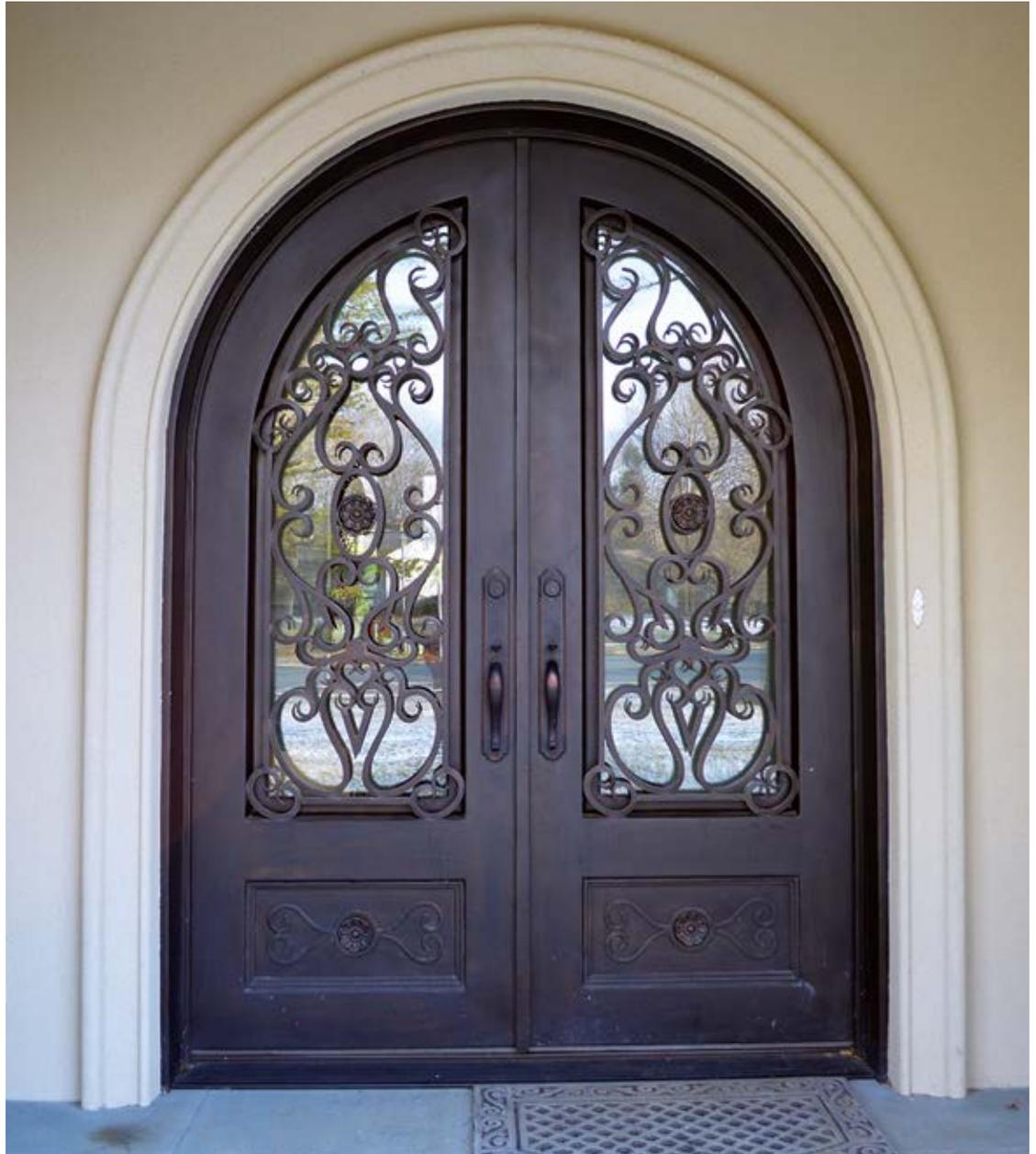


# AFTER DY

IN THE WAKE OF SUPERSTORM SANDY'S RAZING OF NEW JERSEY'S COAST, THE NEED FOR SUPERIOR BUILDING MATERIALS LIKE PRECAST CONCRETE WALL SYSTEMS HAS BECOME ABUNDANTLY CLEAR.

By Sue McCraven

▶  
*(at right and on preceding page) Dave Jensen, owner of this stunning precast concrete home in Lincroft, N.J., said, "My house is so quiet inside! It's very energy-efficient because of the high R-value of the insulated Superior Walls. Precast concrete is more expensive up front, but I don't consider that much of an issue because it went up fast, has excellent fire resistance and no seams for air or water penetration. Precast didn't limit the custom architectural elements we wanted, like our arched entrance door and curved windows."*  
Photos courtesy of Dave Jensen.



A full autumnal moon, hauling up her swelling tides along our East Coast, joined forces with a rare convergence of weather fronts. This weather trifecta force-fed the approaching hurricane, bloating Hurricane Sandy into a 2,000-mile-diameter freak of nature and establishing it in the record books as the biggest Atlantic storm ever. And despite Sandy's seemingly laid-back approach on those last days of October 2012, her lethal intent was a direct, full-throttle collision with New Jersey's beautiful shores, a state treasure.

"Within 10 minutes, the water rose above 5

ft," claimed one trapped resident. Other besieged homeowners said, "You can't even imagine the force of the water, the wind – the fear." "The water just rose so rapidly that there was no escaping it." "The force of the water just blew homes apart."

In the first days of 2013, two months after Sandy's 14-ft storm surge receded, New Jersey's shocked and devastated coastal residents were finally allowed access to see what little remained of their neighborhoods. After the extent of destruction sunk in, people turned their hopes and concerns to the future: "We are waiting to see if we can afford to rebuild to revised FEMA<sup>1</sup> codes."

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<sup>1</sup> Federal Emergency Management Agency's (FEMA's) mission "supports our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards." NFIP (National Flood Insurance Program) is managed and funded by FEMA. U.S. taxpayers fund FEMA and therefore pay for all reimbursements to eligible homeowners for flood-damage insurance claims.

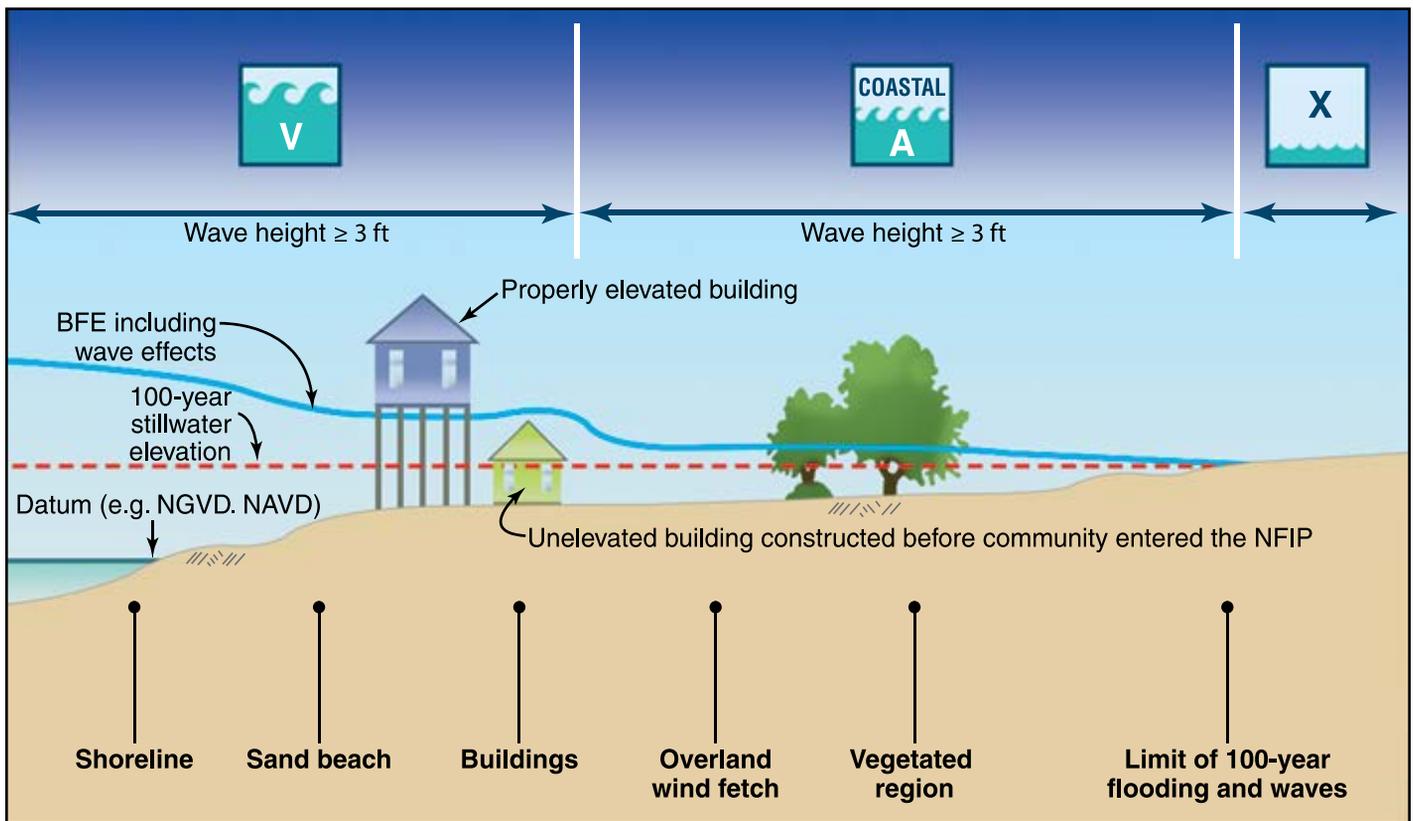


Figure 1

“Rebuild stronger and smarter.” This is Sandy’s terrible lesson – and the objective of the Federal Emergency Management Agency (FEMA). During nasty weather – from tsunamis to tornados – owners testify that they feel safe and secure in their precast concrete homes, and precast safe rooms meet FEMA’s strict criteria for near-absolute storm protection. If the Jersey Shore needs strong and sustainable rebuilding solutions, strong precast systems fit the bill.

### A RECIPE FOR DISASTER

Almost 9 million residents make New Jersey the most densely populated state in the country, and 60% of its people live along a shoreline that isn’t much higher than sea level. Intense shoreline development continued for many decades despite climate experts’ warnings of certain calamity from rising seas and the likelihood of monstrous storms.<sup>2</sup> The Jersey Shore is home to its vital seaside ecotourism, a big-moneyed power broker in

state and local politics.

Even with the state’s Home Rule that relegates flood zoning decisions to local jurisdictions, Jeff Kolakowski, vice president of government affairs for the New Jersey Builders Association (NJBA), said, “New Jersey has strong environmental protection policies, and all construction must comply with state laws as well as local zoning ordinances.”<sup>3</sup>

According to Anthony Bevilacqua, president of Anthony & Co. Inc. Insurance, a New Jersey Property & Casualty insurance agency in Flemington, “You’ll find every style of construction from modest vacation homes to luxury full-time residences along our 130-mile coastline. It is estimated about 60% of these properties are primary residences. Not all property owners know flood insurance rates are based on FEMA elevation guidelines.”

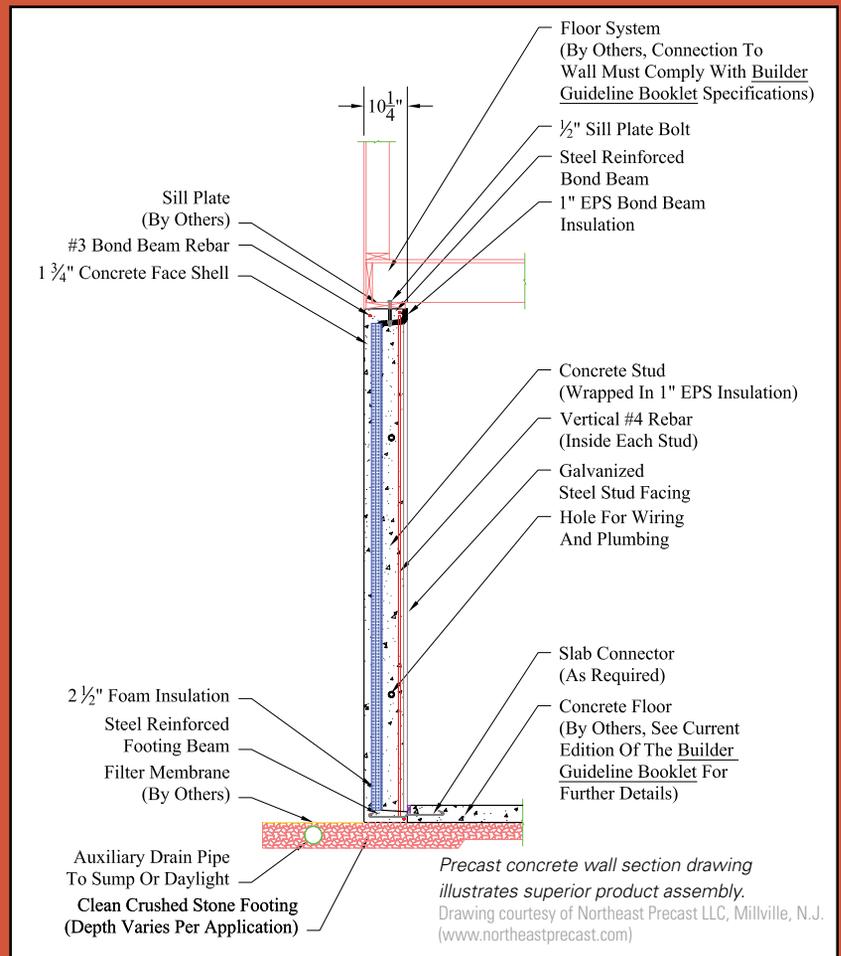
The National Oceanic and Atmospheric Administration’s Weather Service (NOAA) reported that New Jersey has not experienced a storm of Sandy’s magnitude in recorded history. Put in human terms, Bevilacqua said, “Two generations of coastal residents have no recollection of anything like Sandy.” So it isn’t news that New Jerseyites were unprepared, because superstorms were never part of this state’s culture or collective consciousness. New Jersey’s history, demographics, culture and intense shoreline development, taken together, created a precariously cantilevered cauldron and a recipe for disaster.

<sup>2</sup> “New Jersey: Assessing the Costs of Climate Change,” National Conference of State Legislatures & the University of Maryland’s Center for Integrative Environmental Research, *Climate Change and the Economy*, 2008, ISBN 978-1-58024-512-8 (See References).

<sup>3</sup> New Jersey builders must obtain a permit from either The Division of Codes or Standards, which enforces the Uniform Construction Code, or The Coastal Area Facility Review Act (CAFRA) for shore development. New laws and regulations that provide additional protection to coastal communities include the Flood Hazard Area Control Act and Stormwater Management rules.



Photos depict the quality control in the production of insulated precast wall panels at Northeast Precast LLC in Millville, N.J.  
Photos courtesy of Northeast Precast LLC, Millville, N.J. ([www.northeastprecast.com](http://www.northeastprecast.com))



## 10 REASONS TO REBUILD WITH PRECAST CONCRETE INSULATED WALL SYSTEMS

1. Superior Strength: steel-reinforced 5,000 psi or greater concrete strength, steel-reinforced studs (24 in. on center) and footer; monolithically poured in production for greater strength
2. Smart: ready to finish with pre-engineered utility access holes built in; galvanized steel stud facing; installs in hours; integral concrete facing shell
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4. Warm: insulation in walls makes home warmer in winter, cooler in summer; no additional thermal barrier required
5. R-Values 10.5 or up to R-Value = 50; energy efficient construction; 10 1/4 in. wall thickness
6. LEED Points/Green Approved Product: National Green Building Council certification; up to 8 LEED points available; recycled content; local materials and labor (see [www.greenapprovedproducts.com](http://www.greenapprovedproducts.com))
7. Custom Manufactured: meets specifications of owner, including wall heights, openings for windows, doors and flood vents per FEMA
8. Quality: NPCA-certified, plant-quality produced
9. Fire Resistance: Two-hour fire separation wall with two layers of Type X drywall
10. Rapid Installation/Minimum Site Disruption: fast erection in most weather conditions; minimal adverse environmental impact from construction activities; safer job site with fewer workers and heavy moving equipment

Superior Walls Insulated Precast Concrete Walls, see [www.northeastprecast.com](http://www.northeastprecast.com) or [www.superiorwalls.com](http://www.superiorwalls.com)

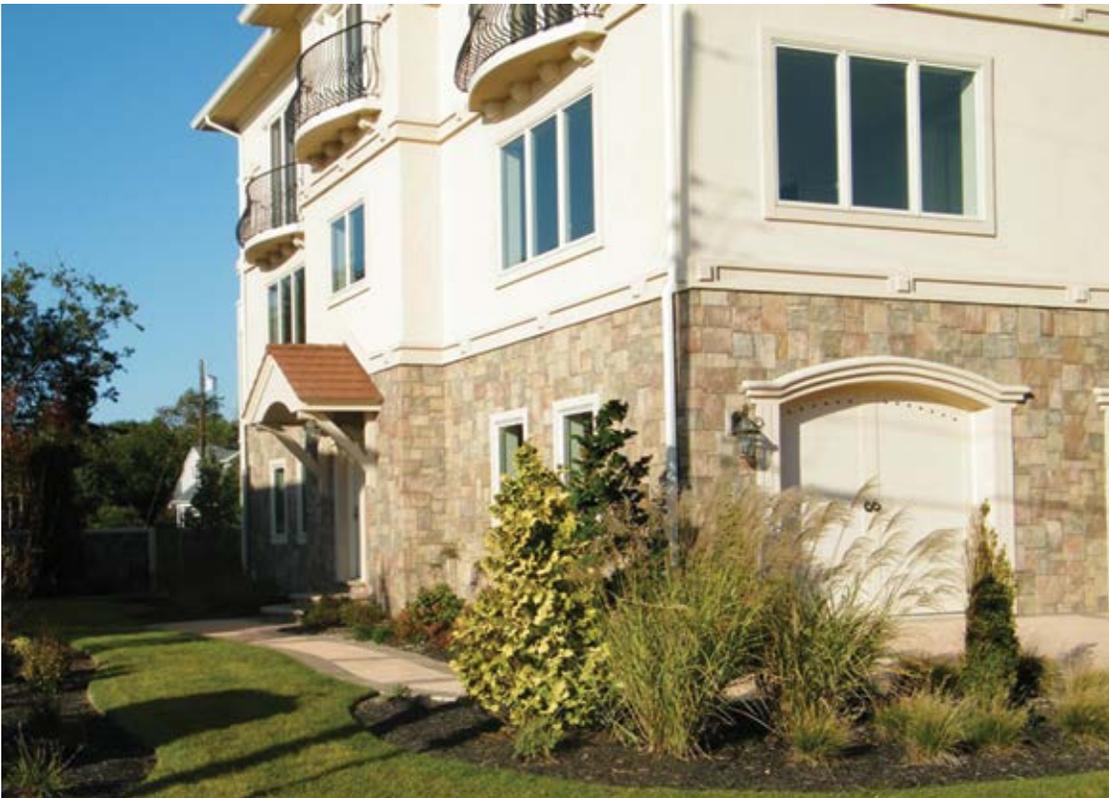
### “CAN I AFFORD TO REBUILD?”

To help residents rebuild and get their lives back to normal as soon as possible, Gov. Chris Christie isn't waiting for FEMA to come out with new base flood evaluations (BFEs) later this year. He enacted

an emergency bill in January to adopt FEMA's interim advisory base flood evaluations (ABFEs) so that homeowners can decide if they can afford to rebuild their homes in compliance with new, post-Sandy guidelines.<sup>4</sup>

<sup>4</sup> FEMA guidelines apply to buildings that sustained damage equal to 50% of their value.

These building guidelines are especially critical for those living in the V-Zone (high-velocity waves 3 ft above storm surge level – see Figure 1) where FEMA is



◀  
*(clockwise from top-left )  
 Strong, water-resistant and sustainable precast concrete products are erected for a Jersey Coast home. With high quality plant-produced elements, residential construction is completed faster than homes built with traditional construction materials.*

*Photo courtesy of Northeast Precast LLC, Millville, N.J.  
 (www.northeastprecast.com)*

*Workers complete the rapid precast concrete triple-stack construction of this New Jersey coastal home.*

*Photo courtesy of Northeast Precast LLC, Millville, N.J.  
 (www.northeastprecast.com)*

*Completed precast concrete home on the Jersey Shore presents tasteful architectural elements while the strong precast walls ensure the homeowner's security and peace of mind that this durable construction resists storm forces and water penetration.*

*Photo courtesy of Northeast Precast LLC, Millville, N.J.  
 (www.northeastprecast.com)*

expected to raise BFEs by 4 ft (see Figure 2) for first-floor construction. With only four in 10 homes insured for flooding, George Vallone, president of Hoboken Brownstone Co. and NJBA executive officer, said, "The big question after Superstorm Sandy is whether or not people can afford to rebuild." In the past, flood insurance rates have not reflected the true cost of rebuilding, even with generous federal subsidies. But Sandy's catastrophic impact on the state changed everything.

**"REBUILD SAFER & STRONGER" = STRUCTURAL INTEGRITY**

FEMA is calling for stronger and safer structures for New Jersey's rebuilding efforts<sup>5</sup> that Christie said

will require many years of hard work, given the scope of Sandy's devastation. With fond childhood memories of family vacations spent at the shore, Christie has an unshakable commitment to ensure a smart, resilient and sustainable resurrection of what he calls the "Heart of New Jersey."

What is the No. 1 concern of coastal residents? "You want to be able to return to your home after a storm and see it standing there, completely intact," said Dixon Barbee, a representative for Northeast Precast LLC in Millville, N.J., who works with homeowners, builders and contractors daily and knows firsthand what people are going through. If you want your family to be able to return home after Mother Nature has reminded us who is boss, you'll need "rebuilding materials with proven, engineered structural integrity," said Barbee.

Only superior materials, like reinforced, insulated precast concrete wall systems, can offer security and peace

<sup>5</sup> FEMA "Rebuilding After Hurricane Sandy – Rebuilding Safer and Stronger Pays Off," December 2012, www.Region2Coastal.com

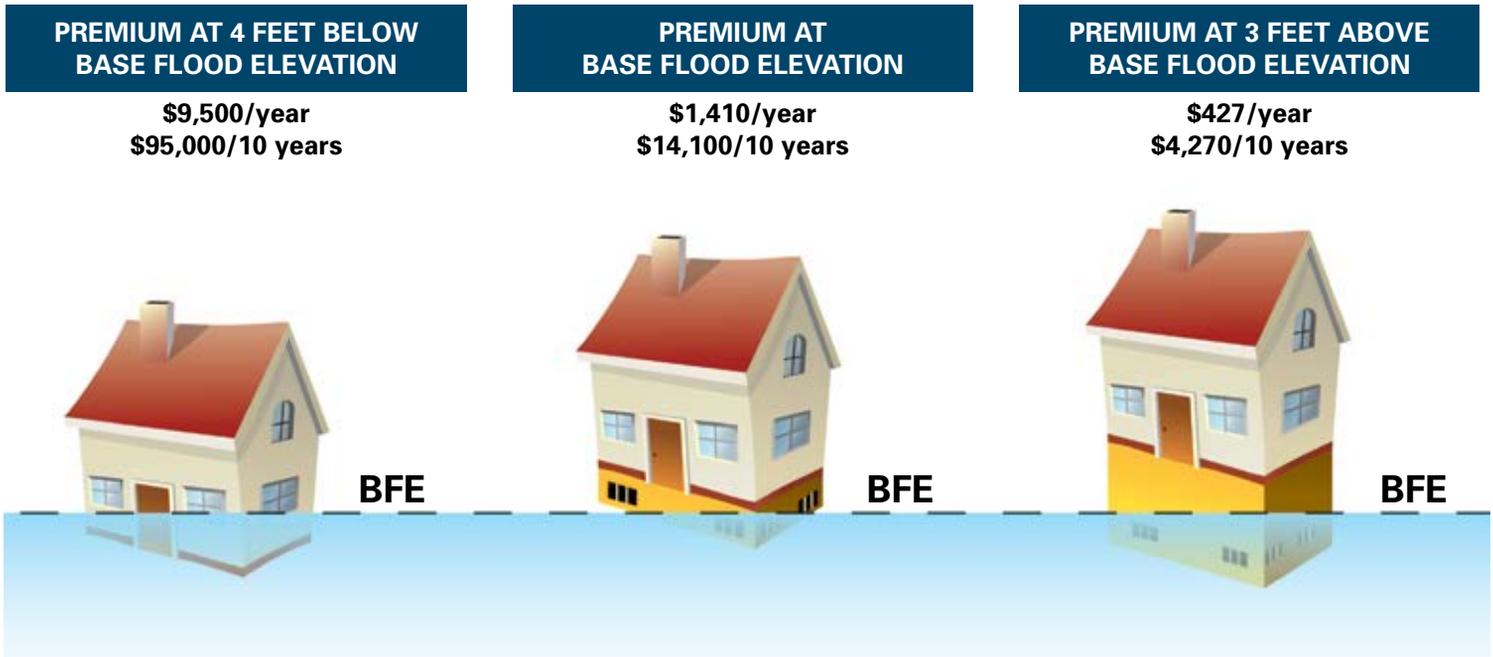


Figure 2

of mind. It no longer makes common or fiscal sense to rebuild to the old status quo. As FEMA advises, “Rebuilding safer and stronger pays off.”

FEMA requires piles and breakaway walls (nonstructural coverings designed to wash away under surge forces) for first-floor construction in the V-Zone. Northeast Precast is one of the region’s precast concrete manufacturers that produce Superior Walls,<sup>6</sup> an insulated and steel-reinforced precast concrete building system that is both strong and sustainable. Precast can be used to great advantage in FEMA’s A-Zone reconstruction efforts. Wood pilings are preferred in the A-Zone, and in some cases these pilings will be cut off at grade. A grade beam can then be poured on the sawed-off piles as a secure foundation for upper stories. A precast concrete lower story with surge flow-through vents and upper stories will guarantee a barrier against water penetration.

Traditional building materials (wood frame, brick and CMUs) have proven to be inadequate for high-risk flood zones. Precast concrete products are installed rapidly with minimal site disruption, meeting Christie’s demand that people who have lost their homes can “return to normal as soon as possible.” Precast also fulfills his goal to rebuild with resilient, durable materials (see the

<sup>6</sup> Superior Walls is a patented, warranted, insulated precast concrete wall system that is steel-reinforced and a Green Approved Product that is custom manufactured to each building’s specifications. Superior Walls of America manufacturers are independently owned and operated. [www.superiorwalls.com](http://www.superiorwalls.com)

sidebar “10 Reasons to Rebuild with Precast Concrete Insulated Wall Systems” for product details).

### **FEMA, Gov. CHRISTIE & MOTHER NATURE: REBUILD STRONGER**

Unfortunately, many residential contractors are not familiar with the benefits of precast concrete home building systems. When they hear “precast concrete,” many misinformed owners, and even some experienced builders and contractors, think of anything made of “concrete” as poured-in-place concrete basement walls that often leak when built near high water tables or in flood zones. Although engineers, builders and Christie realize they need to specify more durable construction to meet FEMA’s rebuilding guidelines, strong and durable precast concrete building systems are often not on their radar.

Owners deserve to hear the true cost/benefit analysis between precast concrete and traditional building materials – valid comparisons that include strength, safety, energy savings and service life. Exceptional materials have a higher initial cost, and that’s true in every product or service market.

It can’t be denied that most prospective homeowners, builders and local jurisdictions are looking for the cheapest solution. But Sandy’s lesson tells us there is no longer any viable rationale for rebuilding in flood zones with traditional construction that proved its structural inadequacy.

Compared with other building materials, the



*Insulated, steel-reinforced precast concrete walls held strong against Superstorm Sandy at Barnegat, N.J., just 300 ft from Barnegat Bay. Homeowner Scott Nevins tells his story of returning home with his wife and baby after surge waters receded.*

Photo courtesy of Northeast Precast Co., Millville, N.J. ([www.northeastprecast.com](http://www.northeastprecast.com))

## MY HOUSE WAS IN GREAT SHAPE AFTER SANDY

By Scott Nevins, Nevron Electrical Contractors, Toms River, N.J.

My house is about 300 ft. from Barnegat Bay, leeward of Long Beach Island. Strong winds came in Sunday night, and in the morning we decided to leave with our 16-month-old. Our road would flood soon, and we knew we wouldn't be able to get out if we didn't leave quickly.

When we returned two days later, trust me, houses were completely trashed. With precast concrete walls, ours was in great shape. Lower-level flood vents let the 18-in. surge pass through. I power-washed the concrete-finished garage walls. That's it. No shredded, wet drywall, nothing lost, no water damage, no repairs, no mold.

I estimate a piling foundation around \$8,000 and precast walls at \$15,000. I honestly think the precast is worth it, because otherwise you still have to pay a carpenter to build breakaway finish walls around pilings, your garage is freezing, and you now have to put in insulation and new sheet rock to hold the insulation in. I worked it out to a \$4,000 differential for precast walls.

And precast walls are installed already finished, insulated and tight with steel throughout and at the corners.

overriding benefits of precast concrete make it the smartest choice for many of New Jersey's rebuilding efforts. With its proven strength, energy efficiency and structural integrity, precast's higher initial cost is more than repaid through greater public safety, storm resistance and a long, long service life. **ps**

*Sue McCraven, senior NPCA technical consultant and Precast Solutions editor, is a civil and environmental engineer.*

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Photo courtesy of Gate Precast  
(gateprecast.com)



**PEROT MUSEUM OF  
NATURE AND SCIENCE:**

# **A WORK OF ART AND SUSTAINABILITY**

By Claude Goguen, P.E., LEED AP



**A**s the sustainable building movement continues to evolve, so have its architectural design possibilities. Incredible edifices are being constructed all over the world that are environmentally conscious and resource-efficient throughout their life cycles. A shining example of this trend can be found in Victory Park near downtown Dallas. The large, striated cube made of precast concrete and glass that seems to float in mid air houses the new Perot Museum of Nature and Science, and it is a breathtaking sight to see.

Opened in December 2012, a month ahead of schedule, this \$185-million project was designed by Thom Mayne, a Pritzker Architecture Prize laureate. The tower, the largest part of the museum, is made

up of 70,000 sq ft of precast panels; a plinth section consisting of 220 panels, or 27,000 sq ft of curved panels; and the atrium inside the tower containing 100 panels.

Gate Precast supplied the precast concrete architectural panels. A case study on the Gate website states that, "The 180,000-square-foot museum was designed to resemble a sedimentary geological formation. The precast concrete facade satisfies the intent to reflect the geology and stratification of the earth's surface through the creation of undulating forms, which are rigorously systematic but seemingly random."

Gate Precast worked with the design team to define the cladding through the creation of mock-ups



*Stripping curved architectural panels at Gate Precast's Hillsboro, Texas, production facility.*

Photo courtesy of Gate Precast (gateprecast.com)



(top-left)  
A production worker trowels the curved surface of a custom precast concrete panel.

(bottom-left)  
Finishing an architectural precast panel after removal from its custom form. Photo courtesy of Gate Precast (gateprecast.com)



This view allows the observer to experience the bends and curves, and the angles and eccentricities of the museum. Photo courtesy of Gate Precast (gateprecast.com)



with varying horizontal striations. The panel design incorporates both convex and concave horizontal striations. “The random combinations lend striking shadows, and the striations give way to smooth concrete surfaces on higher levels of the building,” according to the case study.

For the cube portion of the building, precast concrete panels averaged 8 ft tall and 28 ft long with alternating 20-degree sloped ends. “The plinth panels were curved, canted and radiused to follow a serpentine path around the site,” the case study states.

According to the architect, the precast facade “minimizes the use of material through a systematized, standard panel that maximizes modularity, interchangeability and the appearance of a complex,

dynamic facade.” The panels were designed and organized into categories of forms or families from which rubber molds were created.

“The resultant precast concrete facade satisfies the intent to reflect the geology and stratification of the earth’s surface through the creation of undulating forms, which are rigorously systematic but seemingly random,” the case study said.

### INSTALLATION CHALLENGES:

Installation of precast on this project was meticulous even with extensive planning. Erection of the precast panels was painstakingly slow due to the amount of survey work required prior to setting each individual panel to ensure the structure itself was correct. The unconventional methods used to erect such complex pieces also added obstacles. About five panels were erected per day on the tower, two per day on the plinth area and one per day in the atrium area.

Due to the curvature on so many different panels, the precaster’s engineering department was required to provide a “face of panel” dimension to each corner of every panel so that the surveyors could locate exactly where the panel face should be in its correct erected position.

Erection and aesthetic tolerances take on a new meaning on the plinth panels, which track around the site perimeter. This wall of precast runs for approximately 1,400 lineal ft and includes 25 different points of radius along its journey.

The precast staging area was “large enough to stage



*The random combinations lend striking shadows, and the striations give way to smooth concrete surfaces on higher levels of the building.*  
Photo courtesy of Gate Precast (gateprecast.com)

three to five trailers near the tower, making erection as efficient as possible,” according to an article on the museum in ENR Magazine. Due to the sloped ends of each panel, erection could proceed only in one direction around the building so that the panels could be installed one under the other more easily.

### SUSTAINABLE DESIGN

The building was able to achieve LEED Gold certification. This achievement was aided by the use of concrete panels that incorporated recycled materials and that were manufactured locally to satisfy the Regional Materials credit. There was no waste generated on site as the panels were fabricated at the plant and shipped to the site, ready to install. The use of precast concrete also contributes to minimizing energy due to its thermal mass.

This museum is truly a testament to the versatility of architectural precast concrete. Its impact will be felt by many generations of families who enter its doors, but not by the surrounding natural environment thanks to forward-thinking designers and manufacturers.

### RESOURCES:

- Gate Precast: View a photo library and read more at: <http://www.gateprecast.com/#/case-studies/perot-museum-of-nature-and-science>
- ENR Texas & Louisiana Online Magazine: <http://>



[texas.construction.com/texas\\_construction\\_projects/2011/1017-ConcretecrewsdecipherpuzzlingperotProject.asp?page=3](http://texas.construction.com/texas_construction_projects/2011/1017-ConcretecrewsdecipherpuzzlingperotProject.asp?page=3)

- Take a virtual tour of the Perot Museum of Nature and Science, hear from architect Thom Mayne and see the stages of construction at: [www.perotmuseum.org/about-the-perot/](http://www.perotmuseum.org/about-the-perot/) **ps**

*Claude Goguen, P.E., LEED AP, is NPCA's director of Technical Services.*



Photo courtesy of Travis Von Bureun

How to

# ENHANCE MECHANICAL CONNECTIONS

CHOOSING THE RIGHT CONNECTION FOR YOUR PROJECT HINGES ON  
MANY FACTORS – FROM FUNCTION AND EASE OF PRODUCTION TO  
CONSTRUCTABILITY AND SURFACE AESTHETICS.

By Evan Gurley

**T**he behavior of connections used in precast concrete products greatly influences the structural integrity of the entire structure.

Whether analyzing large precast concrete wall and floor panel junctions or the load transfer mechanisms used in precast concrete pavement slabs, the design and construction of the joints and connections are crucial components that ensure the stability and robustness of the structure. The overall integrity of the precast concrete structure can be substantially enhanced by minor changes in the amount, location and detailing of connections and connection hardware.

## EXAMPLE: EXOTIC PRECAST TEMPLE

The Baha'i Temple in Wilmette, Ill., is considered to be the first architectural precast structure constructed in the United States. The precaster on the project, John Joseph Earley of Earley Studio, used innovative mix designs and manufacturing methods to create

the exterior shell of this exotically beautiful structure. Construction on the temple began in 1919 and the doors subsequently opened in 1953. It was constructed using architectural precast concrete panels bolted to a steel and concrete skeleton using expensive stainless steel connections that eliminated the possibility of rust.

Even at the start of this temple's early 20th century construction, connections played a vital role. For example, proper connections ensured that the precast panels were correctly positioned and held in place, they resisted the vertical and horizontal loading conditions, and they prevented the architectural components from rust and other damage to architectural aesthetics.

## CONNECTION PERFORMANCE CRITERIA

As defined in ACI 318,<sup>1</sup> a connection is a region that joins two or more members. The primary purpose of

<sup>1</sup> ACI 318, "Building Code Requirements for Structural Concrete and Commentary"

  
*(opposite page)*  
*The Baha'i Temple in Wilmette, Ill., took over three decades to build and was the first architectural precast structure built in the U.S. The specified stainless steel connections were costly, but have proven their worth over time by protecting the temple's magnificent surface aesthetics, as seen in this dramatic nighttime photo.*  
Photo courtesy Chris Smith Photography  
(Chris@outofchicago.com)



a connection is to transfer the load to the supporting structure, restrain movement, and/or to provide stability, depending on the structure or component. Precast concrete manufacturers use numerous sizes, shapes and types of connections.

It is common for precasters to develop their own connection details to best fit their production and erection needs. If this is the case, the precast manufacturer is typically included early in the design stages, as it may be able to provide additional insight and address any questions that may arise.

In order to ensure that the connections in a precast concrete structure or component meet the minimum design and performance criteria, let's consider the following factors:

- Building Code and industry standards requirements
- Economy of erection
- Constructability of connections
- Simplicity of connections
- Connection hardware

*Codes and standards.* Connections used by precasters must comply with the applicable governing codes and standards, which outline the materials, design and construction of structural precast concrete products in buildings and other structures. Codes and standards provide a means of establishing minimum requirements for acceptance of design and construction.

When reviewing the ACI 318 code, we see numerous sections highlighting the minimum standards for connections in precast concrete building elements. These requirements touch on all types of connections used by precasters when dealing with building system elements.

Connection issues arise on projects, and each must be solved on its own merits following the limitations set by the building codes.

*Economy of erection.* If the connection makes the precast component difficult to handle, the speed of erection slows. This reduces the efficiency of installation and increases the overall cost. With proper up-front planning by the engineer and precaster, connection issues can be significantly reduced or eliminated altogether to increase the speed, efficiency and economy of erection.

When precast concrete wall panels make up the exterior envelope of a building, the economy of erection dictates that the connections be designed to allow the crane to set the panels in place with temporary

anchorage/bracing, permitting the crane to advance to the next piece. Alignment and permanent anchorage can then be accomplished without the use of a crane. This is just one example of how a proper connection detail allows the installation process to be more efficient.

*Constructability.* Constructability can ultimately reduce the fabrication period. It includes the following criteria:

- Avoidance of congestion
- Simplicity of connection design
- Repetition of standard connection designs and types
- Integrity of tolerances and clearance for connections and connection materials/hardware
- Allowance for field adjustments
- Accessibility of connections
- Avoidance of form penetrations
- Elimination of unnecessary work (post-stripping)
- Shortest crane hook-up and erection time

*Simplicity.* Connections should be designed to be as simple and practical as possible. Simplicity should be one of the chief goals in designing all connections, as each complication adds to the expense of installation. In some cases, local practice may suggest one type of connection over another, such as the use of bolts rather than welds. All connections need to be accessible and allow for tolerances and adjustments.

The precast concrete manufacturing process has a significant advantage over alternate construction processes, as precast products are manufactured in a quality-controlled environment that ensures the precise placement of connections to match exacting specifications and tolerance restrictions.

*Connection Hardware.* Hardware designed for connections should take into account the tolerances for both the precast concrete components and the structure. These may require clip angles and plates with slots or oversized holes to compensate for dimensional variations in elevation. Sufficient minimum clearance between precast units and other structural components should be provided to allow for product, interface and erection tolerances. Hardware should be designed to compensate for additional stress at maximum anticipated clearance.

Other important factors to consider include strength, ductility, volume change accommodations, durability and fire resistance.

## TYPES OF ARCHITECTURAL CONNECTIONS

There are numerous types of connections for all precast concrete products, but the most common connections for architectural precast concrete components are:

- Bolted connections
- Welded connections
- Dowel/anchor bolt connections

*Bolted connections.* Bolted connections simplify and speed up the erection operation, because the connection is immediately strong. Final alignment and adjustments can be made later without tying up a crane. Staggered bolt layout allows easier access for tightening with a pneumatic wrench for bolted connections. High-strength bolts may be snug-tightened (bearing connections) or slip-critical (clamp-like connections).

*Welded connections.* Welded connections are most commonly used in the erection of precast concrete. Welded connections are structurally efficient and adjust easily to varying field conditions.

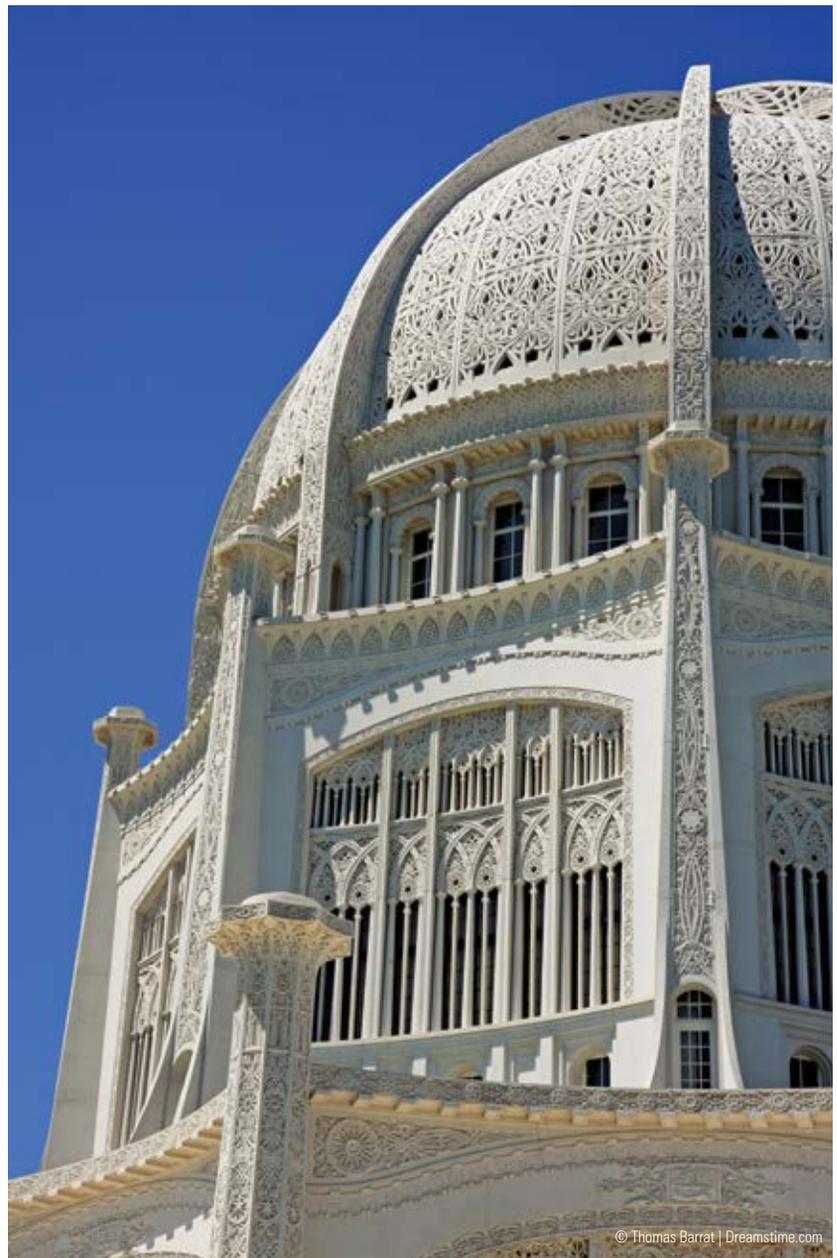
*Dowel/anchor bolt connections.* The strength of dowels in tension or shear depends on dowel diameter, embedded length, bond development and loading. Recommended practice is to provide sufficient embedment to develop full dowel strength. Typically, dowel work is performed by a subcontractor.

For more information on architectural connections and connection details, visit the NPCA website at [precast.org](http://precast.org) to view the Architectural Connections Guide (see Sources).

## CONCLUSION

Precast concrete systems enable fast and effective completion of many types of buildings and other structures. Effective design and construction are achieved through the use of suitable connections to cater to all service, environmental and ultimate load conditions.

Connecting the elements is not just a question of fixing one piece to another; it is to ensure the structural integrity of the whole structure. To achieve structural integrity, the designer must appreciate the critical importance of connections and understand how connections influence the flow of forces through a structure under shear, vertical and/or horizontal loads.



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## SOURCES

- [precast.org/wp-content/uploads/2012/01/ArchitecturalConnectionsGuide.pdf](http://precast.org/wp-content/uploads/2012/01/ArchitecturalConnectionsGuide.pdf)
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*Close-up photo of the Baha'i Temple reveals the amazing intricacy and exacting detailing of the structure's celebrated aesthetics.*

Photo courtesy  
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*Evan Gurley is a technical services engineer with NPCA.*



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