

High-Performance Architectural Precast Concrete:

Creative Aesthetic Possibilities

By Dirk McClure



When an exterior wall system is designed and specified, it typically must meet several criteria related to function and performance. Precast concrete can be easily designed to include high-performance structural attributes, and it also can be manufactured in a variety of colors and finishes. This article does not discuss insulation-, reinforcement-, and fenestration-related design issues in precast concrete; rather, it focuses on the expected aesthetic criteria and standards for architectural precast concrete from producers certified by the Precast/Prestressed Concrete Institute (PCI).

FINISH OPTIONS WITH PRECAST CONCRETE

Precast concrete provides a variety of finish options. The most common are sandblasted, acid-etched, exposed aggregate, and polished (Fig. 1).

Sandblasted

Traditionally, sandblasting has been the most common finish for precast concrete. Abrasive sandblasting partially exposes the aggregates, leaving a rough and relatively dull finish. There are varying degrees of sandblasting: light, medium, and heavy, each yielding a different appearance.

Acid-Etched

Acid-etching creates a clean and consistent appearance. Depending on what sands are used in the concrete mixture, an acid-etched finish can have a glimmering, sparkling appearance similar to a sugar cube. Light, medium, and heavy finishing levels are available. This is many designers' favorite precast concrete finish.

Exposed Aggregate

An exposed aggregate finish is traditionally referred to as a "retarder" finish. This finish exposes more of the rock than a sandblast finish, leaving a rough rock appearance. To achieve this finish, a chemical retarder is applied to the bottom of the production bed, which keeps a fraction of an inch of concrete on the surface of the exterior face from curing. Once the precast



Figure 1. A variety of precast concrete finish options within two different concrete mixture designs.



Figure 2. Examples of thin brick formliners and applications used at Globe Life Field ballpark, home of the Texas Rangers, in Arlington, Texas. Photo courtesy of Jacia Phillips | Arch Photo KC and Enterprise Precast Concrete.

concrete is extracted from the production bed and stood up in the plant, a high-pressure wash removes the retarded paste and surface-level concrete, exposing the coarse aggregate as the primary visual material.

Polished

A polished precast concrete finish is achieved through a mechanical process that leads to a smooth, shining, reflective surface that resembles granite. It is the most costly of the finishing options. Though polishing is commonplace for concrete floors, it is not as common for vertical surfaces. However, polishing can certainly be used with great success as a vertical surface finish for precast concrete.

Mixing Textures

When considering design options for precast concrete projects, budget is always an important factor. One way to help contain costs while providing aesthetic versatility is to use texture for aesthetic effect. For example, Figure 1 shows various textured finishes on two panels, each with a single-color concrete mixture design, demonstrating that multiple looks can be achieved by mixing textures on the same panel. This approach typically costs less



than casting multiple-color concrete mixture designs within the same panel.

Adding Other Materials

Other materials that are commonly set into precast concrete include thin brick, inset tiles,

and natural stone. When using thin brick (Fig. 2), designers are by no means limited to simple running bond patterns. Other options include arches, stacked bonds, bump-outs, and mixing various sizes of brick, including standard, modular, or Norman.

Depending on the material, the process for casting thin brick shapes into precast concrete varies. Clay-based products such as thin brick or terra-cotta tile can be directly adhered to a precast concrete panel system. The difference between the amount of shrinkage in the concrete and the amount of expansion in the clay is negligible and typically does not cause issues; using brands of thin brick that have been through 300 cycles to test resistance to freezing and thawing is advisable.

Thin natural stone (such as granite or lime-

stone) requires a thin film called a “bond breaker” to be installed between the precast concrete and the stone to provide separation between the dissimilar materials. The stone is then typically connected with steel pins (also known as hairpin anchors) that are adhered to drilled holes in the natural stone.

PCI'S NEW ARCHITECTURAL CERTIFICATION PROGRAM

A critical quality control measure for projects using architectural precast concrete is to

select precasters that have demonstrated their competence and abilities through certification. PCI offers the most stringent and most widely accepted certification program for the vertical precast concrete project industry. To maintain certification, precasters agree to a minimum of two unannounced two-day audits per year, per plant, so that independent inspectors can verify the producer's conformance to a variety of industry standards. Working with PCI-certified precasters thus reduces the risk for projects because these prequalified producers have demonstrated that they can meet those standards.

In a transition that has been years in the making, PCI has launched a revised certification program for architectural precast concrete producers that includes the highest certification requirements to date. In developing the new Architecture Certification Program requirements, PCI received input from over 160 producers, architects, and contractors with a great deal of experience working with precast concrete.

The new certification requirements took effect October 1, 2021. Producers that were previously certified by PCI for architectural precast concrete were required to obtain new certification in applicable categories by this date.

The revised program expands the number of architectural precast concrete categories in which precasters can become certified, which will help owners and designers better identify producers based on their capabilities. The previous PCI certification program had three primary certification categories:

- A1—Architectural Cladding and Load Bearing Units: Specification 034500. This category was relevant for architectural cladding projects and high-end wall panel projects. This general category was essentially a “catchall” for architectural precast concrete panels.
- CA—Commercial Grade Products with Architectural Finish: Specification 034100 (structural categories also include C1, C2, C3, and C4). Category CA was relevant for larger-scale structural projects such as warehouses or “big box” stores.
- AT—Architectural Trim Units: Specification 034500. This category, which continues to be used in the revised program, is relevant to precasting of smaller pieces (trim, sills, headers, medallions, monument signs, etc.).

In the revised program, there are five certification categories:

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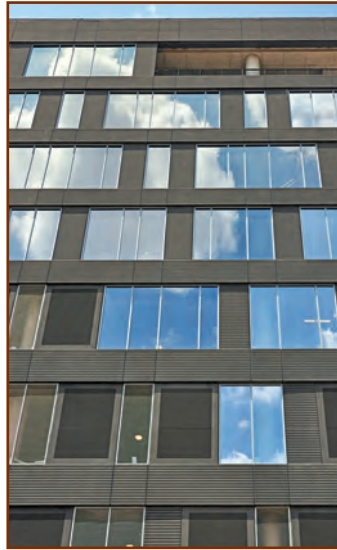
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Category AD



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Category AA

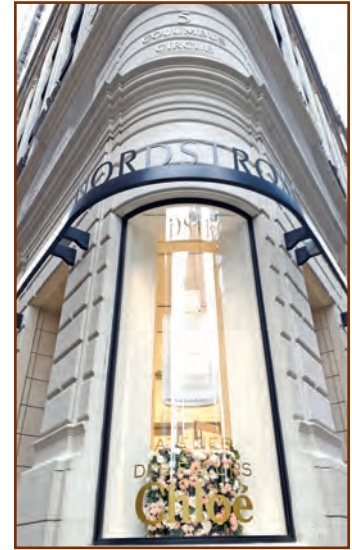


Figure 3. Examples of projects aligned with the Precast/Prestressed Concrete Institute’s AA, AB, AC, and AD certification categories for architectural precast concrete producers. Photo credits: Category AD (Springhill Elementary Gym & Safe Room): Stiler and Henry Photography; Category AC (5th & Race Street Development): High Concrete Group LLC; Category AB (University of Minnesota Pioneer Hall Renovation): InsideOut Studios, Rick Peters/Wells Concrete; and Category AA (Nordstrom NYC Flagship): GATE Precast Company.

- AA—This category is for projects requiring the greatest level of aesthetic complexity. This certification is for producers of highly complex shapes and has the tightest tolerances ever required (that is, tolerance requirements greater than those specified in PCI MNL 117,¹ which was previously the highest architectural concrete quality control standard).
- AB—Similar to AA, this category places great emphasis on shapes and alignment tolerances. The tolerances for AB, like the previous standard A1, are specified in previous PCI MNL 117 standards. If the design has curved walls or involves embedding any other materials into the precast concrete (other than or “in addition to” thin brick), the project must be specified as AB (or AA).
- AC—This category is for projects requiring a standard level of aesthetic complexity for non-load-bearing wall panels and PCI MNL 117 tolerances. (Generally speaking, this current category is most similar to the previous A1 certification).
- AD—This category is for producers of structural elements with some architectural finishes (similar to the previous CA certification). PCI MNL 116² (the previous structural concrete quality control standard) is the reference standard.
- AT—This category is for producers of

architectural trim elements (small pieces, monument signs, medallions, etc.). PCI MNL 117 is the reference standard.

While certain buildings were built to the AA and AB standards in the past, the AA and AB classifications did not exist as minimum certification standards until the now. Through this new certification program, PCI is raising the attainable standards for architectural finishes for precast concrete. Producers certified at a higher level can bid on and produce any work that is certified at the lower levels, but

producers gaining certification at the lower levels cannot bid on or produce work at the higher levels (without first achieving that specific certification level). Many producers have chosen to only pursue certification at the AC and AD standards because those standards are more in line with their core competency and typical business model, and there is nothing wrong with that, as you will see in the following examples. Each category represents a high-quality standard (at various levels). While specifying at PCI levels AA or AB might result in getting less bids overall, the proposals received will be from precasters that have proven themselves at those

The revised program expands the number of architectural precast concrete categories in which precasters can become certified, which will help owners and designers better identify producers based on their capabilities.

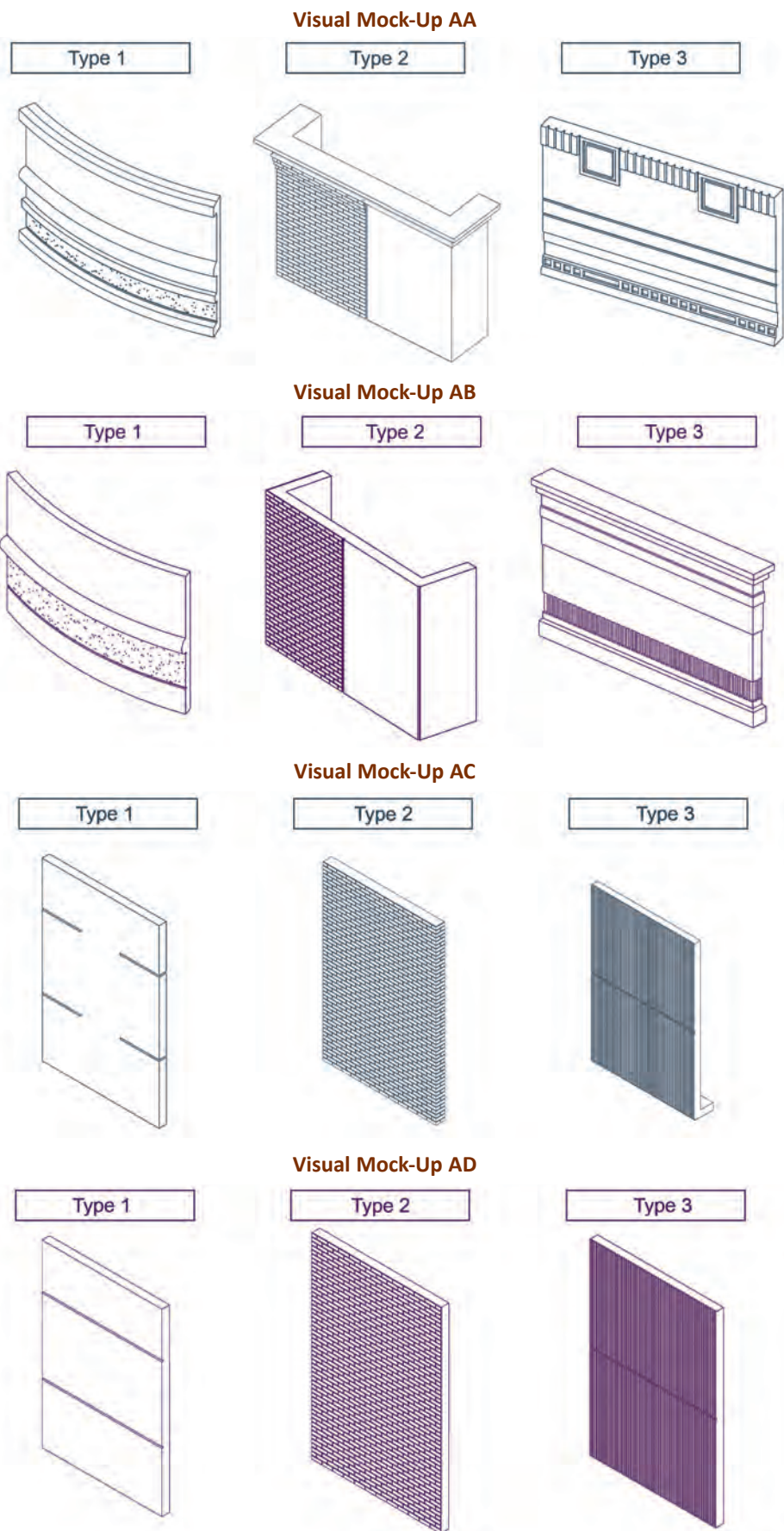


Figure 4. Examples of mock-ups required to achieve certification in categories AA, AB, AC, and AD of the Precast/Prestressed Concrete Institute's Architectural Certification Program. Credit: Precast/Prestressed Concrete Institute.

levels through the certification process.

Figure 3 presents examples of representative projects for each category.

Mock-up Requirements

Figure 4 shows mock-ups that precasters must produce to achieve certification in a specific category. For category AD, producers need to be able to produce flat panels. For category AC, producers need to be able to make a return at a corner.

For category AB, producers need to be able to introduce curves, if required. They also need to be able to introduce multiple mixture designs and multiple finishes within the same panel. For thin brick, they need to effectively transition from thin brick to exposed precast concrete on the same panel surface. Note also the much increased level of complexity for the category AB mock-up compared with categories AC and AD.

For category AA, an even greater level of complexity is required, along with tighter tolerances. The market has been calling for this for some time, and with current technology, that is finally possible.

The AT standards have remained relatively unchanged. However, the mock-up requirements are more rigorous to better ensure producer capability.

Other Category-Specific Requirements

For the AT category, producers must be able to produce single-color trim components, single-pour returns, and radius pieces. AT certification matches requirements of the current PCI MNL 117 standard. As long as AT certification is maintained by the plant, there is no requirement for a site survey. **Figure 5** shows an example of a precast concrete medallion that might be produced by a precaster with AT certification.

For the AC and AD categories, producers are required to be able to effectively produce single-color panels. The cement color for AC projects is often white (but gray may be used if allowed in the specifications). For AD projects, gray cement is typically used. Many AD projects are warehouses or "big box" stores that will be painted in the field.

Producers certified in categories AC and AD need to be able to use formliners, embedded thin brick, and single-pour returns in their products. However, AC- or AD-certified producers do not need to produce radius panels. PCI quality control

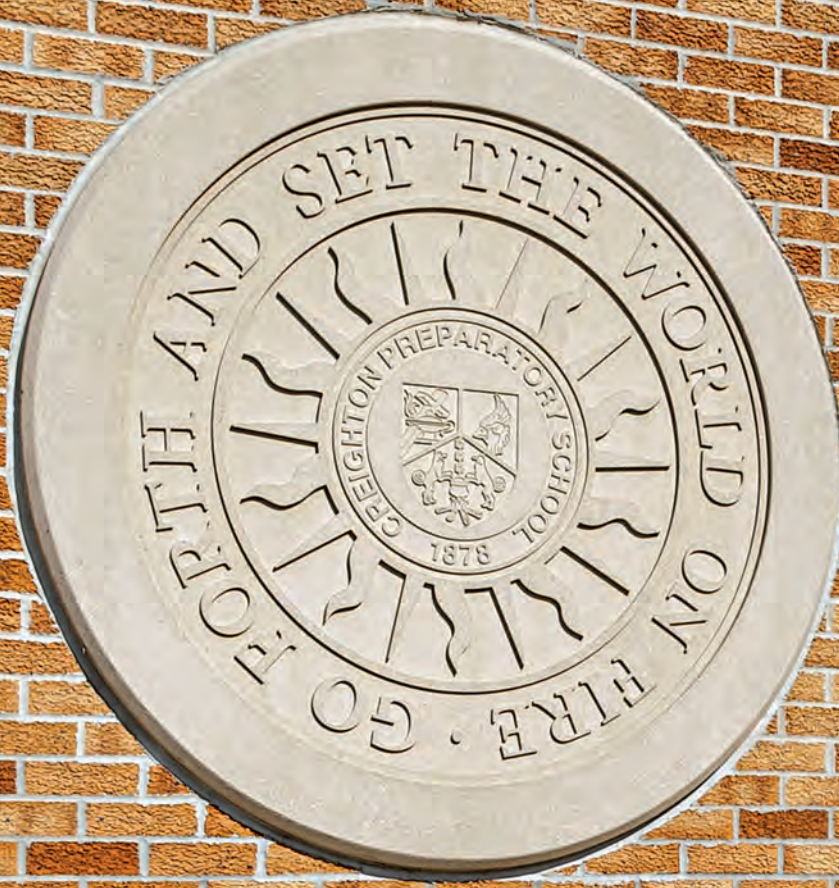


Figure 5. Example of a project with precast concrete medallions, which would be best produced by precasters with category AT certification from the Precast/Prestressed Concrete Institute Architectural Certification Program. Photo courtesy of Jacia Phillips | Arch Photo KC and Enterprise Precast Concrete.

level 1 or 2 certification is required of precasters in these categories. AC or AD certification does not require an architect or contractor survey (or site) evaluation, but these producers are subject to the full plant certification requirements.

AC certification matches requirements of the current PCI MNL 117 standard. AD certification matches the previous PCI MNL 116² standard. For AC-level certification or higher, plants must use a PCI-certified erector to install components on the project. **Figures 6** and **7** show examples of projects that would be classified in categories AD and AC, respectively.

The AA and AB categories are new certifications for producers working on projects that require the highest possible architectural precast

concrete standards, such as cathedrals, performing arts centers, and upscale wall panel projects (**Fig. 8** and **9**). Obviously, buildings of these types have been previously built with architectural precast concrete, but PCI did not certify producers in these areas of expertise.



Figure 6. Example of a project produced by precaster with category AD certification from the Precast/Prestressed Concrete Institute Architectural Certification Program—Middlesex Center Warehouse in Jamesburg, New Jersey. Photo courtesy of Altus Group and Oldcastle Precast.

Figure 7. Example of a project that would be best produced by precasters with category AC certification from the Precast/Prestressed Concrete Institute Architectural Certification Program—DC West Elementary School in Valley, Nebraska. Photo courtesy of Jacia Phillips | Arch Photo KC and Enterprise Precast Concrete.





Figure 8. Example of a project produced by a precaster with category AB certification from the Precast/Prestressed Concrete Institute Architectural Certification Program—Capital Federal Hall in Lawrence, Kansas. Photo courtesy of Jacia Phillips | Arch Photo KC and Enterprise Precast Concrete.

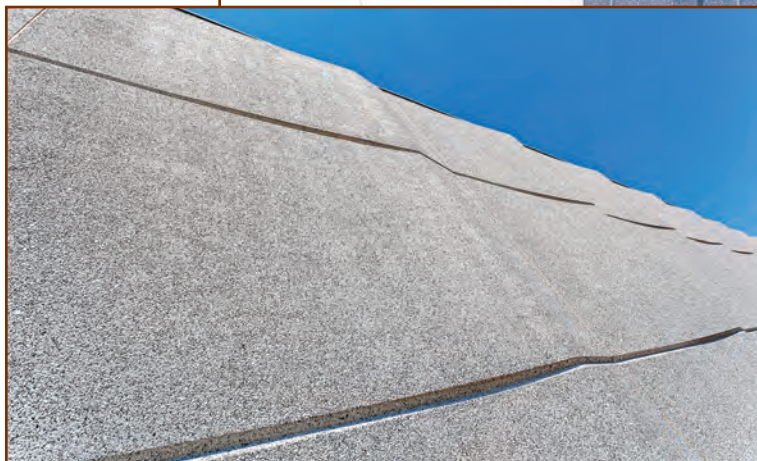


Figure 9. Example of a project produced by a precaster with category AA certification from the Precast/Prestressed Concrete Institute Architectural Certification Program—Advanced Learning Library in Wichita, Kansas. Photo courtesy of Jacia Phillips | Arch Photo KC and Enterprise Precast Concrete.

Requirements		Certification Category					Notes
		AA	AB	AC	AD	AT	
Color and Finish	More than one colored mixture (admixture) and texture per panel (capability for white cement) (must include different texturing methods)	X	X				
	One colored mixture (admixture) and texture per panel (gray cement allowed)			X	X	X	
Embedded Material and Veneer	Brick, tile, stone, terra-cotta	X	X				
	Thin brick			X	X		
Panel Geometry	Flat panels	X	X	X	X	X	
	Flat panels with sequential returns	X	X				Two-part return
	Flat panels with single-pour returns			X		X	
	3-D form surface (buildups, liners, projections on face)	X	X				
	3-D form surface (reveals and liners only)			X	X	X	
	3-D panels and radius (concave, convex)	X	X			X	

Note: Current A1 certification is similar to AC attributes noted in the chart.

Table 1. Selected Precast/Prestressed Concrete Institute's architectural certification category requirements
Credit: Precast/Prestressed Concrete Institute


AB and AA producers must be able to produce multiple color mixtures within a single panel. While gray cement can be used (if the specification allows), most of these projects will likely use white cement because it yields greater quality control. Precasters with AB or AA certification also must be able to produce architectural precast concrete with embedded stone, tile, and terra-cotta (in addition to thin brick, which is also a requirement for AC and AD producers). AA and AB producers can provide cold joint returns and three-dimensional formed surfaces through projections (via specialty forming buildups) and curved panels. Given this level of controlled production environment, the AA and AB categories require a worker at the plant to have PCI's quality control level 3 personnel certification. This is a greater requirement than that needed for AC and AD categories, which, as previously noted, require workers who have PCI quality control level 1 or 2 personnel certification.

The AA certification process includes a survey by PCI of the architects and general contractors involved in recent projects by the producer seeking certification or recertification, as well as a PCI site visit audit. AB certification does not require a site audit but does require the project survey of architects and contractors. These survey requirements help ensure PCI obtains sufficient feedback about the producer's work and accountability.

AA certification has tighter tolerances than the PCI MNL-117 (the previous architectural

concrete quality control standards), which is a level that did not exist in the previous certification categories. Tolerances for AB certification match those of the current PCI MNL 117, but with increased complexity. The use of PCI-certified erectors is required for categories AA, AB (and AC). Additionally, AA and AB precasters must have building information modeling capabilities to qualify for these certifications. A precaster can help in advising which specific certification category is most appropriate for architects to specify specific to their individual projects.

CONCLUSION

This paper has provided a quick overview of types of architectural precast concrete and the new PCI certifications for producers. Refer to **Table 1** for a synopsis of key PCI certification criteria and visit the PCI website (www.pci.org/archcert) for more information. 

Editor's Note: A webinar covering the content in this article is available for free on demand through the Architect's Newspaper Continuing Education Webinar series. To access the webinar, visit www.cestrong.com/courses and select "ALT CES 130—Specifying High-Performance Precast: Creative Aesthetic Possibilities."

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Dirk McClure

Dirk McClure is the director of business development for Enterprise Precast Concrete. Working out of Kansas City, he oversees the five-state market territory of Kansas, Missouri, Illinois, Oklahoma, and Arkansas. He received a bachelor of interior architecture from Kansas State University's College of Architecture, Planning, and Design. Prior to joining the precast concrete industry in 2004, he spent eight years practicing sports architecture. His diverse architecture, design, and construction industry background has given him a unique overall knowledge of the built environment.