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NPCA is a trade association representing the manufacturers of plant-produced concrete products and the suppliers to the industry around the world.

18 Confidence, Compassion, Collaboration

With a commitment to teamwork and its employees, **Tindall Corporation** is poised for continued expansion.



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TEST ANXIETY?

Essential tips for mastering the **Crane Operator Certification Exam**.

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On the Cover:

Workers install a precast concrete arch culvert manufactured by Tindall Corporation for an equestrian center in Mill Spring, N.C.

photo by Tindall Corporation

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Questions from the Field

Questions from the Field is a selection of questions **NPCA Technical Services engineers** received from calls, emails and comments on blogs or magazine articles on precast.org.

If you have a technical question, contact us by calling (800) 366-7731 or visit precast.org/technical-services.

Troy writes:

We deliver precast concrete and no matter how careful we are, we battle with the age-old issue of marks, road dirt, chips and anything else associated with damage – no matter how large or small.

Is there an industry standard that says visual inspection must be performed at a specific distance?

NPCA Technical Services engineers answered:

Two specific references come to mind regarding architectural surface acceptance by mockups. In ACI 303R-04, “Guide to Cast-in-Place Architectural Concrete Practice,” Section 2.1.1 uses a distance of 20 feet for visual acceptance. PCI MNL-117, “Quality Control for Plants and Production of Architectural Precast Concrete Products,” references a distance of 20 feet or more as agreed upon by the architect, owner, contractor, etc., in Section 1.5.4 and again in Section 2.10.

Douglas writes:

I have a question regarding joints in precast concrete wet well sections. We have been reviewing precast drawings that show the use of molds to increase the height of a section. The lower portion of the section is poured to a depth of +/- 72 inches with the reinforcing exposed above the pour to allow setting an upper mold to increase the section depth to +/- 113 inches. The reinforcing steel meets lapping requirements but the joint has a vertical,

ribbed PVC water stop. ASTM standards C478, C913, C433 and C990 all call for keyed joints with flexible compressible sealants. But this appears specific for joints between cast sections.

Per these ASTM standards, are water stops allowed during the precasting process?

NPCA Technical Services engineers answered:

Our understanding is that the precaster has an existing 6-foot-tall form and wishes to make a single integral section of 9 feet, 5 inches. Because this section will consist of two separate pours, a PVC water stop will be cast into the junction position of the sections. Typically, the need for a taller or extended manhole section is due to a pipe connection that cannot be avoided to hit a standard manhole vertical joint. Sometimes, precasters (with contractor consent) will furnish a deepened or sump manhole section to pull the conflicting manhole joint under the pipe connection. However, in some cases, based on the pipe diameters and the respective elevations, a manhole joint cannot be avoided, and the other option is to cast a taller section by a form extension.

To answer your question specifically, what you are describing is a unique structure that isn't specifically covered within ASTM C478, Section 14: Riser and Conical Tops. This construction joint also isn't covered by the traditional bell and spigot joint requirements within ASTM C443 or C990. However, this isn't necessarily noncompliance. What you describe from the precaster – using a properly placed water stop in the secondary pour area – is good practice. And there must be some valid reason they are going to such lengths to get the extra-tall riser section.

This could then relate to ASTM C478, Section 5.2: Modified or Special Design, which states: “Manufacturers are not prohibited from submitting to the owner, for approval prior to manufacture, designs other than those prescribed in the specific section for a product. If such approval is obtained, then the product shall meet all the tests and performance requirements specified by the owner in accordance with the appropriate sections on manufacture and physical requirements.”

The ACI C301 and ACI C350 codes, which permit the use of PVC water stops on cast joints, offer an excellent guide reference on this topic.

Greg writes:

How does one formulate a concrete mix to make concrete panels of light weight and high strength? What special additives are needed?

NPCA Technical Services engineers answered:

Lightweight concrete is essentially standard portland cement concrete that uses a lighter aggregate (expanded shale, clays or volcanic aggregate) in lieu of normal coarse aggregate. The best reference to obtain mix design information is ACI 213R-14, “Guide for Structural Lightweight-Aggregate Concrete.” This document provides history, physical characteristics, design parameters, etc. Chapter 4, “Specifying, Proportioning, Mixing, and



Handling,” would be of interest.

Another resource regarding lightweight concrete is the Expanded Shale, Clay and Slate Institute. For more information, visit escsi.org and search “lightweight concrete.”

There are no secret additives in the concrete industry to enhance strength. The basic formula of a lower water-cementitious material ratio is still the primary factor for concrete strength. There are a variety of admixtures available to reduce your water content while still providing the workability needed to cast what is required. Moisture control is a critical component to be managed.

Another method to lighten precast concrete panels and provide improved insulation capacity (R values) is by producing a sandwich panel. Just as it sounds, these panels are constructed by setting up forms, placing the required reinforcing steel, pouring the concrete to the specified thickness, placing a high-density foam layer atop the first layer of cast concrete and then completing the panel by casting additional concrete over the insulating material. This provides a strong and possibly architecturally pleasing finished panel with improved thermal properties. More on sandwich panels can be found at precast.org/sandwichpanels.

Another means to lighten a precast panel would be to reduce the thickness. Today, with advanced concrete properties, structural sections are being reduced through the use of ultra high performance concrete, enhanced tensile properties with steel reinforcement, or both. UHPC has been used on amazing architectural building components with stunning results. Further information about UHPC can be found at precast.org/uhpcwp and precast.org/uhpcendless. **PI**



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Automating THE FUTURE

Automation is changing the landscape for precast plants by making the production process more consistent, more efficient, safer and less labor-intensive.

By Shari Held

If you're thinking about building a new plant or upgrading your equipment, you're likely going to consider automation. While the initial investment may be high, the dividends that can be paid in increased efficiency, safety and production make automation a sound choice for forward-thinking precasters.

Here's a look at automating a plant from the perspectives of three precasters: Pennsylvania-based Techo-Bloc Corporation (pavers and retaining walls), Georgia-based Foley Products Co. (risers) and Minnesota-based Molin Concrete Products (structural and architectural wall panels).

For Mike Nadeau, U.S. director of operations for Techo-Bloc, automation was a no-brainer. The company built automated plants in 2003 and 2007 and purchased three additional plants in the U.S. It also has three production facilities in Canada.

"There's no other way to do what we do profitably," Nadeau said. "It's the only way to go."

A shrinking labor pool was a chief motivation for Foley Products.

"We're having a hard time finding those daily laborers who want to work hard



Photo provided by Molin Concrete Products

Molin Concrete Products of Lino Lakes, Minn., partnered with Weckenmann to install carousel system technology.

“We were also looking at ways to provide more value in the marketplace with quality, capacities and capabilities,” Westgaard said.

A PERFECT PARTNERSHIP

Partnering with an automated plant system manufacturer relieves precasters of some of the headaches associated with building a new plant, including planning and training.

In 2004, Foley Products partnered with Schlüsselbauer to build an automated, 90-foot-wide by 175-foot-long manhole riser plant. Foley Products also hired a contractor to build the plant to spec, and once it was ready, Schlüsselbauer set up its MAGIC automated production system. Schlüsselbauer then trained the technical-savvy workers Foley Products had hired. By October 2006, the automated plant was up and running.

“The faster and more consistent you can make something, the less waste you have. People make mistakes. Computer programs typically don’t. And they show up for work every day!”

– Mike Nadeau, *Techo-Bloc Corporation*

In 2014, Molin partnered with Weckenmann to convert a conventional, long-line production plant – located 25 miles from its existing plant – to carousel system technology. To reduce its capital investment, Molin requested Weckenmann stay within the footprint of the vacant plant: roughly 85 feet wide and 320 feet long with a 26-foot clear height for the two 25-ton overhead cranes.

By July 2015, Molin poured the first cubic yards of concrete in the new plant. With the carousel system, workers remain stationary while pallets move through the manufacturing plant stations. The system handles everything from setup to cleanup and prepping for the next day’s production.

“We spent the first eight months manufacturing simple, plain gray concrete panels,” Westgaard said. “Then in phase two of the project we added the architectural finishing and the colored and textured concrete aspects of architectural wall panels to the operation.”

WHAT AUTOMATION BRINGS TO THE TABLE

Techo-Bloc specializes in the high-end residential market. The paver industry is highly competitive and product quality can vary widely.

Along with a mix design that helps ensure longer-lasting blocks, the company relies on automation to achieve a competitive edge. With automation, Techo-Bloc can

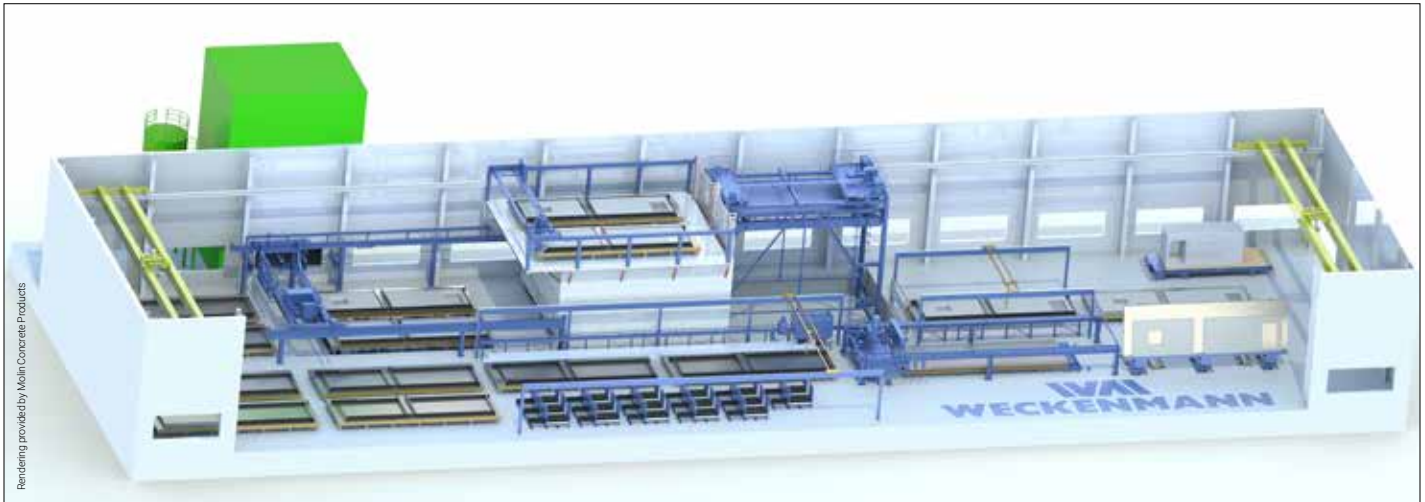
for 10 to 12 hours a day,” said Dennis Morrissey, vice president of dry cast operations. “It was basically a personnel issue.”

Foley Products also wanted to find a more efficient way to perform vacuum testing. Manual testing was time-consuming and labor-intensive. With automation, testing is included in the production process.

Decreasing safety risks and health hazards associated with silica dust, noise, strains and sprains – as well as attracting future skilled labor – was important for Molin.

“We needed to look at how to innovate ourselves so we’d be attractive to a millennial-generation workforce that wants to get into this business,” said Matthew Westgaard, vice president of manufacturing.

Molin’s existing plant wasn’t set up for producing high-volume or high-quality architectural wall panels. The company needed a full package of precast products to keep it from missing opportunities in the marketplace and to set it apart from the competition.



Above: Proper research and development is crucial to achieving success with automation.

Below: Foley Products' automated, 90-foot-wide by 175-foot-long manhole riser plant has helped the company cut down on labor.

produce 11.5 square feet of brick-size pavers in 10 seconds.

"The faster and more consistent you can make something, the less waste you have," Nadeau said. "People make mistakes. Computer programs typically don't. And they show up for work every day!"

Although automation doesn't help Foley Products produce manhole risers any faster, it does cut down on labor. Instead of eight workers, it now takes only three to manufacture 150 elements per day.

"Our overall production cost is a lot less than it used to be – at least 30 to 35% less," Morrissey said. "That allows us to be more competitive."

Automation has helped Molin eliminate human error and manufacture products with a higher quality and more consistent finish. It has also enabled the company to offer more refined architectural surface finishes to the design community.

"The quality of product we're achieving is much higher than what we ever expected," Westgaard said. "We've had a lot of good, pleasant surprises with the operation."

There's also a more consistent pace to production with automation.

"It makes it easier to quote jobs because you have a much

higher level of confidence than when you're looking six, eight, ten, twelve weeks out," he said. "You can have X number of square feet of product manufactured and ready for delivery to a job site."

ADJUSTING TO AUTOMATION

Once Schlüsselbauer finished training Foley Products' employees, it was business as usual. The Foley employees were experienced with dry-casting manhole risers.

"The only thing is, we're doing it with a lot less people," Morrissey said.

One downside he's noted is that the forms now wear out a lot faster.

"But the good part is that the product comes out pretty slick-looking," he said. "Not wet-cast slick, but it's a pretty darn good-looking dry-cast product."

The biggest adjustment Molin had to make was going from being a single-plant producer to being a multiple-plant producer.

"We now have to coordinate deliveries from two different plant locations, both going to the same foreman on one job site," Westgaard said. "All of that's new for our organization."

WHAT THEY LEARNED

Building any precast plant is a costly endeavor, and building an automated plant entails a significant upfront cost, which may seem prohibitive. But Westgaard advises precasters to look at the long-term.

"When we looked at automation as a long-term investment for the organization, weighing it against quality defects, safety hazards and risks, work comp claims and the challenge of limited tradesmen, it was a much easier decision," he said.

Molin hired its plant manager and several production workers early in 2015 even though the new plant didn't start production until July 2015. The new hires were on the floor working alongside the equipment installers months before they received formal training.

"I would highly recommend that any precaster who is contemplating an investment like this and a culture change in how they manufacture products bring their employees in early



so they learn the process from the ground up,” Westgaard said.

Morrissey recommends doing extensive homework. Foley Products spent about two years of development time for its automated plant. Management made several trips to Europe to look at different types of machinery and visited many plants. Then they compared costs. He estimates the cost of building the automated manhole riser plant to be about 40% more than building a more traditional plant.

“It’s a big investment,” Morrissey said. “You’ve got a new building and you’ve got a whole different concept. But if the volume is there, it’s worth it.”

Nadeau echoes that advice, suggesting precasters attend machine shows and select the type of equipment that best suits their needs. For Techo-Bloc, it was just a matter of the level of automation.

The company built automated paver/retaining wall plants in 2003 and 2007. As a result, while other precasters were laying workers off during the Great Recession, Techo-Bloc thrived.

“We took a chance,” Nadeau said. “We thought that when the economy came back we’d be way ahead and we’d take market share. And we lucked out.”

THE BOTTOM LINE

Morrissey is so impressed with the labor-saving advantages of automation that he’s currently talking with Schlüsselbauer about automating an existing plant.

“It’s all about being able to push the envelope of your industry, staying innovative and taking advantage of the latest technologies...”

– Matthew Westgaard, *Foley Products*

And while automation may require fewer employees, Nadeau is quick to point out that computerized automation systems will never replace workers.

“It still takes people to run the equipment – a higher caliber of people who make higher wages,” Nadeau said.

In the end, Westgaard said automation is all about better serving your market.

“It’s all about being able to push the envelope of your industry, staying innovative and taking advantage of the latest technologies to help you become safer, more efficient and more profitable so you can provide higher value and quality in your products.” **PI**

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

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A photograph of a trade show booth. In the foreground, a man with glasses and a purple checkered shirt is talking to another man whose back is to the camera. The man in the purple shirt has a lanyard with a badge around his neck. The badge identifies him as STEWART STEWART ASSOCIATES, a member of the Precast/Prestressed Concrete Institute (PCI). The background shows other attendees and trade show booths under bright overhead lights.

Get Face-to-Face

AT THE PRECAST SHOW

Expert tips on how to
get the most out of
your **Precast Show**
experience.

By Bridget McCrea



Networking with industry peers at events like The Precast Show can pay numerous dividends for your business.

NPCA File Photo

In today's hectic business world, it's easy to let new business and networking opportunities slip through the cracks as you navigate through your day-to-day schedule. But there's one opportunity that you shouldn't miss out on – The Precast Show. Held annually (and taking place this year March 2-4 in Cleveland), this event features an impressive lineup of exhibitors, speakers, networking opportunities and a wide variety of educational offerings.

The value of attending industry events like The Precast Show goes beyond just “seeing and being seen” in today's business world, where face-to-face opportunities can be few and far between.

“In our busy, social-media crazy world we often forget the importance of being in a live face-to-face setting with others from the business community,” writes human engagement expert Thom Singer.¹

“Being active in your industry trade association can bring with it many benefits. There is power in being connected to other people who are active in your line of work, but it can also be easy to talk yourself out of committing to that annual meeting year after year.”

“In our busy, social-media crazy world we often forget the importance of being in a live face-to-face setting with others from the business community.”

– Thom Singer

BIG OPPORTUNITIES, SHORT TIMEFRAME

While attending industry conferences, seminars and/or educational opportunities has proven to be one of the best things anyone can do for the future of their businesses, many professionals ignore these valuable resources.

“Conferences offer the opportunity to be introduced to several industry experts in a short amount of time – typically over a two- to three-day period – and most importantly allow you to network with others who work in your field,” writes Zach Bodack.² “[For example], an industry expert who's a good seminar speaker – which most tend to be – will provide you with a magnitude of usable content that will be beneficial to your work and industry insight almost immediately.”

Ron Sparks, general manager at Columbia Precast Products in Washougal, Wash., concurs. He's been in the industry since 1991 and has attended The Precast Show nearly every year since 2002. He explained that a prompt from his manager at the time pushed him to check out the event.

“I've pretty much been to every one ever since, with the exception of the one or two that took place during the most recent economic recession,” Sparks said.

Early on, Sparks gleaned the greatest benefit from seeing firsthand the many different pieces of state-of-the-art equipment NPCA's supplier members and other exhibitors displayed and demonstrated.

“I was able to interact one-on-one with a large number of vendors and within a short period of time,” Sparks said. “And while we talk on the phone with these suppliers on a regular basis, seeing them in person helps us develop more camaraderie with them.”

Sparks says the “live” product demonstrations and being able to ask questions help him better understand “what's coming down the pipeline,” and then take that knowledge back to his company to share with the rest of his team. On the educational front, Sparks said he's sent numerous employees to NPCA courses both at and outside of the annual trade show.

In 2016, Sparks sent two employees to St. Louis to take live Precast University courses. He said he plans to enroll even more employees in the program this year.

Ultimately, he noted NPCA's educational offerings – both at the show and year-round – are extremely valuable because they cater specifically to precasters.

5

Reasons to Attend THE PRECAST SHOW 2017

1

Take advantage of educational opportunities.

No matter how experienced you are at your business, everyone can learn. “The educational aspect of a conference can expose you to new ways of conducting your business and help you discover how to be more productive,” writes Thom Singer.

2

Network with your peers.

Industry conferences provide a great opportunity to network. “Often competitors from other regions of the country can become valuable resources for referrals and best practices,” Singer notes.

3

Find new vendors and suppliers.

Hit the trade show exhibit hall hard, work the floor and do what Sparks does – find out everything you can about the latest and greatest technology, equipment and supplies. “This is a great way to learn about what’s hot, what’s not and what your firm should be doing to stay in front of the competition,” Sparks said.

4

Learn what your competition is up to.

The Precast Show lets you do this without having to go to great lengths, since their business information will be much more accessible than usual. This will allow you to benchmark your own company against competition, evaluate your strengths and assess any potential weak points.

5

Attend seminars and keynotes.

Trade shows offer attendees the unique opportunity to do this within a very short period of time, so be sure to take advantage of it. During these sessions, you’ll also meet new people and be exposed to even more networking and business opportunities.

LEVERAGING KEY OPPORTUNITIES

As president of Shea Concrete Products in Amesbury, Mass., Greg Stratis has a lot on his plate at any given time, but that never stops him from attending The Precast Show and other NPCA events. On most occasions, he arrives at the annual event prepared to meet with various suppliers and business partners. Stratis also leaves time open to meet new people, share ideas and cultivate relationships that help both he and his company work smarter, better and faster.

In the interest of “giving back” to the industry that he’s worked in for more than two decades, Stratis also shares his own best practices with colleagues in hopes of helping other firms achieve their productivity and efficiency goals.

“If we’re doing something as a company that we feel would benefit either the association as a whole or its individual members, we bring it to the table at The Precast Show and share it with others,” he said.

Stratis, the current NPCA Chairman of the Board, said attending the annual show helps him realize the value of participating in the group’s numerous committees. Initially, he joined the Stormwater Product Committee because the firm he was working for was deeply involved in that segment of the industry.

“I learned a lot from that experience and was able to take that knowledge back to my company,” said Stratis, who also leverages the educational opportunities offered at the show. “Regardless of where I was at in my career, I’ve always taken educational courses at NPCA’s conventions and shows.”

“There are a lot of very knowledgeable people who attend the show and very good educational opportunities for all employees – from the production employee to the ownership level.”

– Dean Wolosiansky,
Lindsay Precast

IF YOU THINK IT WON’T PAY OFF, THINK AGAIN

Dean Wolosiansky, general manager at Lindsay Precast in Canal Fulton, Ohio, said he started attending NPCA shows within a year of joining the industry. Intent on learning the ropes from other precasters and getting a “broader view” of the industry, Wolosiansky explained that the experience gave him a good idea of where his company was positioned in relation to other firms.

“There are a lot of very knowledgeable people who attend the show and very good educational opportunities for all employees – from the production employee to the ownership level,” said Wolosiansky, who has taken everything from entry-level precast courses to more specialized classes on industry regulations and compliance at the annual event. “It’s never dull. There’s always something new and fresh to learn.”

To producers and suppliers planning to attend the upcoming Precast Show, Sparks recommends reaching out to vendors in advance to see if they’re attending and to set up one-on-one meetings, dinners or coffee breaks.

“I’ve found that the networking and meetings work best when you reach out and set at least a few things up in advance,” he said. “But don’t forget to also leave some time open to meet and mingle with new people and explore new opportunities.”

Asked to share his best piece of advice for new or prospective show attendees, Stratis shared a simple message: If you think you don’t have time to attend the show, think again.

“Some people may feel like this takes time away from their businesses, but in reality, they’ll be able to gain so much back by attending,” he said. “Whether it’s a new idea, a best practice or an answer to an efficiency problem, the networking alone will cover the cost and time associated with attending the show.” **PI**

Bridget McCrea is a freelance writer who covers manufacturing, industry and technology. She is a winner of the Florida Magazine Association’s Gold Award for best trade-technical feature statewide.

RESOURCES:

- 1 mastercardbiz.com/2013/06/19/5-reasons-you-should-attend-a-conference-in-your-field
- 2 globaldns.com/blog/bid/152899/The-Importance-of-Attending-Industry-Conferences-Seminars

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The type of mixer used plays a major role in sequencing.

NFCA File Photo

Sequencing in Mix Design

Precasters must consider **order** when establishing **proper mix** designs.

By Debbie Sniderman

Precasters spend plenty of time understanding the materials that go into a concrete mix design. But what about the order in which those materials are added to the mix? Sequencing, or the order precasters use when introducing components into a concrete mix, is critical. Proper sequencing can help admixtures work, save wear and tear on mixers, compensate for mixer age or performance, help avoid problems such as balling or inhomogeneous mixing, and allow producers to attain the desired final properties for their products.

TAILOR TO THE MIXER

The most important factor affecting sequencing is the type of mixer used. According to Paul Ramsburg, technical sales specialist at Sika Corp., precasters use a variety of mixers but most are central, stationary, batch-type mixers located at the plant. At computer-controlled central mix plants, initial blending occurs on conveyor belts and mixing occurs on one batch while the next one is simultaneously created.

The number and type of mixing cycles in a sequence specify how long it takes to introduce different materials into the mix.

Mixing times will vary depending on the mixer, batch size, admixture recommendations, and the plant's basic philosophy about wet and dry cycles during batching.

The order materials are introduced into the mixer and the energy of mixing determine concrete's microstructure and performance, as well as mixing methods and mixer conditions. Mixing order affects efficiency, and every mixer and mixing method has advantages and disadvantages.

BATCHING AFFECTS SEQUENCE

Batching, or measuring raw ingredients before mixing by weight, volume or both, is another important factor.

"Sometimes, weight and proportions change based on sequencing choices made during batching," Ramsburg said. "So mixes should be designed to be batched. Since sequencing affects optimizing the mix design, they should go hand in hand."

Frank Bowen, director of quality assurance at Piedmont Precast in Atlanta, noted that batch size matters. For larger, 2-yard batches in their pan mixers, Piedmont creates a dry mix first and then adds the wet ingredients. But when making small test batches less than 2 cubic feet – where a 2-yard mixer doesn't effectively produce conclusive results – the company changes the mixing order. Using small shear mixers, Piedmont starts with about 80% of the wet ingredients and then adds the dry ingredients.

MOST COMMON SEQUENCES AND RULES OF THUMB

The most common sequence is an initial dry mix cycle followed by a final wet mix cycle. First, coarse and fine aggregates are checked for moisture content, weighed and introduced into the mixer. If an air-entraining admixture is necessary, it is introduced with the aggregates. Then, cementitious ingredients are weighed and added to the mix. In the most common mix designs, the initial dry mix cycle blends a homogenous mixture in about 30 seconds.

Ramsburg said dry cycle time depends directly on mixer efficiency. Brand new, aggressive pan mixers can batch quickly, but it can take more than 1 1/2 minutes in older mixers with reduced efficiency. Producers must determine the timing for themselves.

Timing also depends on aggregate type. Some are more easily blended during the first mix, allowing short dry cycle times. Complicated mixes may need longer initial cycles. All are specific to the producer.

After the initial mixing cycle, other admixtures and the remaining water are added and mixed a second time. The wet cycle's final mix time depends on the efficiency of the mixer and what the precaster wants from the mix.

"Sometimes, rash decisions are made during the final cycle to speed up production or quicken the batch," Ramsburg said. "The concrete may look the same when it comes down the chute after trimming thirty seconds off the final mix, but the slump, strength and initial set will be impacted."

Bowen added that the mixer manufacturer will typically provide sequence information, but other parties may assist as well.

"Admix companies and other suppliers with knowledge about local ingredients will provide input," he said. "If using an old or handed-down mixer, analyze it to see its capabilities and if it is appropriate for the goals."

At Piedmont, wet materials are introduced very slowly into the most agitated part of the mix.

"In our planetary counter-current mixers with counter-rotating arms, that spot is at the dead center of the mixer," Bowen said. "We add water slowly at the most violent part in the middle to distribute it evenly and avoid clumping. We add plasticizer and churn the final mix cycle for around one minute.

"Twin-shaft mixers and counter-rotating pan mixers from other manufacturers may use different sequences, especially if they have proprietary differences like more mixing paddles or different rotation speeds that impact the sequence or times."

"Sometimes, weight and proportions change based on sequencing choices made during batching."

– Paul Ramsburg,
Sika Corp.

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SEQUENCING AND ADMIXTURES

Admixtures are the most precise part of the mix design. If not sequenced properly, they could have no effect, or worse, their period of effectiveness may occur too early or too late, which could be detrimental to the concrete. Proper sequencing, storage and use information – as well as known incompatibilities – are listed on technical data sheets that precasters should request from manufacturers. Because they have the largest and most immediate impact if mixed incorrectly, there are some rules of thumb to keep in mind.

Reactive air-entraining admixtures should be introduced into the mix separately without touching other admixtures. They are discharged onto the aggregates or entered into the mix water early, and their doses may change if they are used in cold weather or with hot water. Ramsburg suggested deciding if adjustments are necessary using the second batch of the day instead of making conclusions immediately after the first batch.

Water-reducing admixtures are added after the cement is wetted. The earlier they are added, the longer the mix will hold slump and the easier it will be to distribute throughout the mix, but more chemicals are necessary. If added later, the mix won't hold slump as long, but lower doses can be used, making them more cost-effective.

In the southern United States, retarding admixtures are used throughout the year. The earlier retarders are added to a batch, the more they impact and extend the initial set time. Adding retarders later affects the slump life more and set time less.

Liquid pigments are typically introduced at the beginning of the final cycle with other admixtures. Powders or granular pigments are introduced at different times.

COMPENSATING FOR WEATHER WITH SEQUENCE CHANGES

Changing climates may affect the amount of air in the concrete, so doses of air-entraining agents may need to change to achieve targets. Typically, they are put on the sand, but some put them in the mixer. According to Ramsburg, sequencing air-entraining agents differently may help move the air around to achieve more consistent concrete.

Some plants use retarders and accelerators in hot weather. Ramsburg warned not to add both into the mixer at the same time. Whether the accelerators go into the end of the batch or up front may change throughout the season.

WHEN IT'S TIME TO CHANGE THE SEQUENCE

If there's a problem in the mix, such as clumping or balling, there's likely an issue with sequencing.

Cement and water can clump together and form solid balls that float to the surface and don't mix thoroughly with the aggregate. They prevent the cement from interacting with the rest of the mix and cause inconsistent mixing, lower strength and aesthetic issues. The clumps can form if the cement is added too early or if free moisture in any exposed aggregates isn't compensated for on a wet day. If compensating for free moisture doesn't solve clumping problems, a sequence change could help. Adding superplasticizers before the mix is well blended isolates and highlights the balls. Adding it too late can also create balls.

When the mix is inhomogeneous or if there's foaming, bubbles or segregation, it's a good time to investigate a sequence change. Aesthetics and engineering properties will vary if the sequence is changed, so changes should be made systematically and scientifically.

Ramsburg explained that sequences are typically well established, so any changes should be made conservatively, one at a time.

"Document the mix before the change, and test and document after the change," he said. "Test multiple points from four or five samples in three or four batches to verify results and analyze the effect on strength."

TAKING THE NECESSARY STEPS

Ramsburg stressed that precasters should consider sequencing as part of the mix design and add the concept to their existing design processes. Many producers include sequences on their mix design printouts. He added that companies should allocate resources, including people and processes, to understanding sequencing.

"If a company has a great system now, dedicate some QC time to document what the sequence is," he said. "Several years from now, when a new QC manager takes over or if any questions arise, a process document exists."

If you're just getting started with sequencing, mixer manufacturers – who have literature with recommendations – are a good place to begin. Cement and admixture companies are also great resources. Even though sequencing is viewed as equipment-specific, it impacts everyone's role and the concrete's performance. **PI**

Debbie Sniderman is an engineer and CEO of VI Ventures LLC, an engineering consulting company.

RESOURCE:

C. Ferraris, "Concrete Mixing Methods and Concrete Mixers: State of the Art", Journal of Research of the National Institute of Standards and Technology, Vol. 106, No. 2, 391-399, March-April 2001. fire.nist.gov/bfrlpubs/build01/PDF/b01012.pdf

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CONFIDENCE, COMPASSION,
COLLABORATION

Story and Photos by Mason Nichols





Photo courtesy of Tindall Corporation

W

hen a quarterback throws a touchdown pass, a variety of factors come into play. The offensive line must provide adequate protection, the ball must be thrown accurately and the receiver must be in good position to make the catch. At a high level, the throw seems to involve just two players; however, every single member of the offense must work together to ensure the play's success. In the end, individual performances are important, but it is the collective effort of the team that matters most.

The same principle applies in the precast concrete industry. In order for a company to prosper, all of the contributors – from the newest employee on the production floor to the plant manager with decades of experience – must work in tandem.

For Tindall Corporation, a precast concrete producer headquartered in Spartanburg, S.C., collective effort has been crucial in advancing the

Above: Tindall Corporation's staff relies on close collaboration to ensure success on every project.

Center: Homero Soto, crew leader, strips a manhole riser form.



company for more than half a century. Today, it remains the driving force behind Tindall's continued growth.

FROM THE GROUND UP

William Lowndes III, chairman and CEO, built the business from the ground up. In 1963, Lowndes, who had served in the U.S. Army during the Korean War, purchased Tindall Concrete Pipe Company, a small concrete pipe plant with an acre of land and six employees. He quickly recognized the business needed major changes to expand. As a result, he modified the product line to meet the needs of the market, ceasing production on pipe and shifting focus to septic tanks and manholes, a decision that led to a partnership with Western Electric Co. and major work along the East Coast.

Just five years after acquiring the company, Lowndes again diversified. He purchased forms for the business to begin manufacturing prestressed concrete, a side of the industry that was in its infancy. This marked the early formation of the two major arms of the company – Prestress and Utilities – which have guided Tindall's efforts ever since.

Today, Tindall has grown from six employees to more than 1,000, with five production facilities operating in locations spanning from Texas to Virginia.

SMART MOVES

Over the years, the many great teams Lowndes has assembled have supplemented the strong foundation laid. The team that currently leads Tindall's Utilities Division has been particularly adept at discovering new business opportunities and enhancing operations. Roughly a decade ago, that team took an introspective look at their efforts, resulting in the addition of new product lines.



Tindall's Utilities and Prestress Divisions have plenty of room to operate at the company's headquarters in Spartanburg, S.C.





“ABOUT 10 YEARS BACK, WE COMPLETELY CHANGED OUR APPROACH. WE STARTED IDENTIFYING MARKET NEEDS AND DIVERSIFYING OUR PRODUCT OFFERINGS.”

– Keath Roberts, *plant manager*

“About 10 years back, we completely changed our approach,” said Keath Roberts, plant manager. “We started identifying market needs and diversifying our product offerings.”

The Utilities Division started filling those needs by manufacturing trenches, 3-sided culverts and stair units. As a result, Tindall now has a dedicated stair unit operation running out of its Georgia facility. The Utilities Division supplies these stair units to Prestress Division projects throughout the Southeast.

But the team went even further, analyzing the core of the business to ensure high levels of performance at every step of the production process. According to Joel Sheets, vice president and general manager, the assessment was multifaceted.

“With the changes that occurred 10 years ago, it wasn’t just one thing,” he said. “It wasn’t like, ‘We have to get our quality right.’ It was hand in hand with quality, safety and people development.”

For Roberts, tightening the overall efforts of the Utilities Division was all about pride in production.

“If I’m not proud enough of something that we make to bring my family in here and show it to them, or I wouldn’t want to buy it myself, why would I do what I do?”

The resulting changes were crucial, as they readied Tindall for the impending economic downturn.

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OPPORTUNITY KNOCKS

While many precast manufacturers saw the Great Recession as a hindrance, the Utilities team at Tindall viewed it as an opportunity. Although the suddenness of the recession took everyone by surprise, Jason Traxler, customer service manager, described it as “one of the better things that happened to us.”

Roberts explained that it forced the Utilities Division to continue the evolution that was already underway by reducing waste and creating even more efficiencies in the plant.

“We just had to get better at everything we did, from maintenance on equipment to organization of tools and supplies,” he said.

Prior to the recession, the Utilities Division spent around \$100,000 per year on tools. Thanks in large part to the issues discovered during tough times, it now spends less than half of that, even with a considerably larger workload.

In addition to saving wherever possible, the sales team aggressively promoted new products, resulting in Tindall entering new markets. The Utilities Division also collaborated with the Corrections Division to supplement revenue with federal prison work during the recession. While the Corrections Division handled the larger, six-sided cells, the Utilities Division manufactured plenums, smaller units positioned atop prison cells for mechanical, electrical and plumbing access.

“Plenums helped sustain us for a very long time,” Sheets said. “In those lean years, we were happy to have them.”

Barry Phillips, sales manager, explained that he still takes great pride in Tindall’s ability to navigate through the recession.

“I’m probably the proudest of our performance during those years than maybe any others,” he said. “And that’s saying something, because within the last five years, we haven’t just broken records, we’ve smashed them.”

THE COLLABORATION GAME

Smashing records isn’t an accident. For Tindall, it’s the result of always listening to suppliers and customers to determine their needs. In the earliest days of the business, listening enabled Lowndes to initially expand the company’s product line. In more recent years, it’s allowed Tindall’s Utilities Division to work collaboratively with partners as issues arise.

According to Roberts, when Tindall first entered into the large sewer market, the company experienced an issue with leaking boots in their structures. To resolve the issue, the team contacted the boot manufacturer, and the two parties went over proper installation techniques as well as the capabilities and limitations of the boot product. The end result was a change in the way the precaster tightens the boots.

“Once you get above a 48-inch boot, they’ve now changed how many toggles are used,” Roberts said. “One toggle does not allow the torque to go all the way around the boot, so



Left: From left to right: Joel Sheets, vice president and general manager; Jason Traxler, customer service manager; Jim Hodge, plant manager; Barry Phillips, sales manager; Keath Roberts, plant manager.

Right: Johan Rodriguez and Joe Fiddemon work together to assemble welded wire reinforcing.

now they put three in them. It’s been a huge change for us.”

While Tindall keeps an ear to the ground to fulfill market needs and ensure top-notch quality, the company also keeps an eye out for new opportunities via the Process and Product Development (PPD) team, which is based at the company’s Georgia Division. Sheets explained that a willingness to innovate is shared among all Tindall employees, originating at the top with Lowndes.

“It’s a big part of the Lowndes family influence,” he said. “They want to find the next thing. I think that’s something that’s ingrained in our culture.”

NPCA’S

Huge Value

Though Tindall Corporation has been a National Precast Concrete Association member since 1977, they’ve recently ramped up their participation in NPCA offerings, including webinars and Precast University. Tindall’s first-ever Master Precaster, Joe Sikes, graduated from Precast University at The Precast Show 2016 in Nashville, Tenn.

Learn more about Sikes’ experience in the Master Precaster program on Page 32.

Four years ago, Joel Sheets, vice president and general manager, joined the NPCA-PCI (Precast/Prestressed Concrete Institute) task force that helped bring the two organizations together for The Precast Show. Through the task force, he met Andy Wieser, president of Wieser Concrete Products in Maiden Rock, Wis. As the two got to know one another,

Sheets learned about Wieser Form Fabrication.

It just so happened that Tindall was in need of a form for a large product, so Sheets and Keath Roberts, plant manager, coordinated a trip to Menomonie, Wis., to view the facility first-hand. Both were impressed with what they saw, so they purchased their first form from the company. Today, Tindall has purchased several additional forms from Wieser Form Fabrication.

“That relationship has gone very, very well,” Sheets said. “I would say that’s a huge value we’ve gotten out of interaction with the association.”

Sheets added that Tindall also benefits from the face-to-face networking that occurs at The Precast Show.

“It’s been great,” he said. “We’ve definitely picked up contacts within the industry.”



Research and development from PPD has resulted in a variety of potential new products, including solutions for the oil, gas and chemical industries. The PPD team has also designed the Atlas precast concrete wind tower base, a product that allows wind turbines to reach more than 400 feet into the sky.

WHAT MATTERS MOST

Solid partnerships with suppliers and customers help Tindall ensure financial success, but it's the care that the company provides its employees that guarantees the business's future.

"The most important part of our success has been the culture of professional development and understanding people," Phillips said. "There are no rigid roles. We want to get to know you and understand your strengths."

"THE MOST IMPORTANT PART OF OUR SUCCESS HAS BEEN THE CULTURE OF PROFESSIONAL DEVELOPMENT AND UNDERSTANDING PEOPLE. THERE ARE NO RIGID ROLES. WE WANT TO GET TO KNOW YOU AND UNDERSTAND YOUR STRENGTHS."

– Barry Phillips, sales manager

He added that the management team wants all employees to grow in their positions, something they feel will help them continue to recruit and retain exemplary workers.

Additionally, Roberts explained that Tindall places an emphasis on family, encouraging staff members to attend family functions.

“I have small children, and their sports and school functions are important to me,” he said. “I push that mindset with the employees in the plant. There’s only one time that your kid is 5 years old and is going to sing in the school program.”

To help drive that culture, and as recognition for completing three years with no recordable injuries, the Utilities Division hosted a Family Day event in 2014. For an entire Saturday, Tindall shut down production and staff members were invited to bring their families into the plant for demonstrations. Children flooded into the facility to watch their parents operate machinery and showcase their everyday work.

“To see our plant employees showing off their output to their children was a fantastic picture of what Tindall is all about,” Phillips said.

As Sheets explained, the company seeks to establish a culture where employees believe Tindall is where they want to be.

“We need to care about our folks and make sure that they really know,” he said. “Not just talking the talk, but following through.”

CONFIDENCE AND COMPASSION

Many factors affect advancement in the precast industry, but the one that helps push Tindall’s Utilities Division to the next level is confidence. The management team has developed plenty of it over the years, thanks in large part to the success they’ve experienced in working together. On many occasions, the team in Spartanburg has assisted staff in other locations.

“People throughout the company know that if they need to come up with an idea or need help with anything, to call us,” Traxler said. “The Utilities team takes pride in being a supportive resource for the other divisions in various capacities.”

Roberts agreed, noting that the team is willing to try anything when it comes to developing a solution.

“We’re a confident group of people, and you have to have that to be successful,” he said.

Beyond confidence, team members have developed a great appreciation for one another, which, working in tandem with a commitment to family, permeates throughout the business.

“We have a culture of caring for each other, which I think is very important,” Phillips said. “Having many long-term partners within the company together, you learn to care for them. That ends up being a win-win for everyone.”

“WE’RE A CONFIDENT GROUP OF PEOPLE, AND YOU HAVE TO HAVE THAT TO BE SUCCESSFUL.”

– Keith Roberts, *plant manager*

IT’S GOING TO POP

Tindall has seen plenty of growth over the past few years, something the management team hopes to sustain for the long-term by hiring and developing young employees. Roberts sees plenty of potential for the



company moving forward.

“We’re rapidly outgrowing this facility,” he said. “We intend on satellite Utilities production within Tindall’s four other Prestress Divisions. I definitely see us doing that in the next three to five years.”

Doing so will allow Tindall to further diversify their product lines and ship more products to an even wider customer base. All the while, just like Lowndes did so many years ago, the team will be looking to satisfy the needs of the market.

Jim Hodge, plant manager, has been with Tindall for nearly four decades. He believes the company’s success over the years has been the direct result of the many quality employees who have always worked together – as a team – to advance the business. Thanks to the passion and hard work of the management team in place, he has the utmost confidence in the company’s future.

“Good things are happening, and they will continue to happen,” he said. “My time’s up, but these guys have the reigns now, and it’s going to pop.” **PI**

Mason Nichols is the managing editor of Precast Solutions magazine and is NPCA’s external communication and marketing manager.

Tindall Corporation’s Utilities Division partners with the Prestress Division on many projects.



19 HAMILTON FORM CREATES FUNCTION
CASE STUDY
 MANOR EXPRESSWAY SOUND WALLS
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LOWERING YOUR ENERGY BILL

Save money and enhance operational **sustainability** at your precast plant.

By Claude Goguen, PE., LEED AP

How great would it be to find a way to reduce your energy use, save some money and enhance your operational sustainability? It may be as easy as flipping a switch. Columbia Precast Products of Washougal, Wash., found that retrofitting their plant lighting would save almost \$2,000 per year in utility bills. Their local utility company also offered to cover 29% of the installation cost. This resulted in the project paying for itself in four years and a return on investment of more than 25%.

BUILDING AWARENESS

Finding ways to lower costs while continuing to maintain product quality and sales volume can be challenging. But many National Precast Concrete Association members have discovered that looking at energy use can yield significant results.

The first step is to establish your energy awareness. How much do you really use? This involves a thorough study of your utility bills over the past several months. How does your usage fluctuate during the year? Identify the peaks and valleys. Your energy provider is a great resource to help with this exercise. Many are willing to assist you in your conservation efforts and will offer to visit the plant to perform a free audit.

You can also look at programs such as the Department of Energy's Industrial Assessment Centers, which may be able to offer no-cost

assessments to smaller- and medium-sized facilities.¹ IAC teams are located at 24 universities throughout the United States. They typically identify \$130,000 in potential annual savings opportunities for every manufacturer assessed, nearly \$50,000 of which is implemented during the first year following the assessment. Table 1 depicts typical results of IAC assessments.

TABLE 1: IAC Assessment Results – January to March 2016

Total Assessments	107
Total Recommendations	934
Total Recommended Annual Savings	
Energy Savings	22.7 M Therms
Electricity Savings	147,561,952 kWh
Generation Reduction (approx.)	16.84 Megawatts
Natural Gas Savings	6.7 M Therms
CO ₂ Reduction	0.15 Tons
TOTAL Cost Savings	\$17.32 Million
- Energy Related Savings	\$15.36 Million
- Productivity Savings	\$1.32 Million
- Waste & Water Savings	\$0.64 Million

Industrial Assessment Centers – IAC Update, Spring 2016 ²

Another option is to hire an energy consulting firm. These energy experts can analyze your energy consumption and provide consultation services including negotiating, contracting and monitoring supply. Some of them can also offer employee training. One NPCA member benefit is a consultation service provided by APPI Energy, a nationwide energy consulting firm. APPI helps many NPCA members save money on their energy bills through its consulting service. Visit appienergy.com for more information, and if you partner with APPI, tell them you are a member of NPCA.

Research shows companies that perform well adopt a structured approach to energy management. They establish policies and procedures for long-term results, have senior management's support, allocate staff and resources, establish goals, develop management structures that empower staff to address energy efficiency issues directly and adopt a philosophy of continuous improvement. This may include setting up an energy team or an energy "champion." This person or group of employees can be the core of a successful energy program. Building this team engages and empowers your employees to plan, implement, monitor and evaluate your plant's energy management program. The team could also be responsible for training and communicating results to staff.


WHERE TO START

The low-hanging fruit of any industrial-scale energy management plan is lighting. Only a small part of the energy used in a lighting fixture

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results in lighting – the remainder is lost as heat. Even when lighting is a relatively small part of a plant’s energy use, it may be possible to save considerably on energy by using more efficient lighting systems.

Lighting demand is measured by the quantity of lumen of visible light needed at a certain point of time. The quantity of electricity (in watts) needed to supply the demand for lighting (in lumen) is expressed as the efficacy of the light source (in lumen/watt).

Table 2 shows typical performance of various lamp types.

Lamp	Efficacy (Lumen/Watt)	Typical Lifetime (Hours)	Applications
Incandescent	5-20	1,000	Task
Halogen	<24	1,000	Task
CFL	20-70	8,000-15,000	Task
Fluorescent T-12	60	20,000	Any
Fluorescent T-8	80-100	20,000	Any
Fluorescent T-5	80-105	20,000	Any
Mercury Vapor	30-50	60,000	Hi-Bay
Induction	80	100,000	Exterior, Hi-Bay
High Pressure Sodium	85-150	10,000-50,000	Exterior, Hi-Bay
Metal Halide	70-115	20,000	Hi-Bay
LED	10-120	50,000	Task

Note: Values are typical performance. Performance of individual products may vary. The performance of fluorescent lamps assumes the use of an electronic ballast. Technology development may change the future performance of specific lighting technologies.

TABLE 2: Lighting Performance Based on Lamp Type³

For example, if your plant still uses T-12 lighting tubes, be aware that they can consume a significant amount of electricity. T-8 tubes have about twice the efficiency of T-12 tubes and can last 60% longer. Energy savings of T-8 over T-12 can be around 30%.

Other areas to consider are curing systems and light trucks. These are typically some of your highest consumers of energy, depending on your plant systems and yard layout.

Also examine your HVAC systems. Leaky ducts can waste a significant amount of energy and are generally easy to repair. According to a study by Lawrence Berkeley National Laboratory, repairing duct leaks in industrial and commercial spaces can reduce HVAC energy consumption by up to 30%. The study also showed that duct tape should not be used for leak repair. Aerosol sealants are preferred.

Compressed air systems can also consume a high amount of energy. If you use a lot of compressed air, know that many systems can have very poor efficiency – typically about 10% from start to end use. If compressed air is used, it should be at a minimum quantity for the shortest possible time.

GETTING TO IT

Lowering energy use may not take as much energy as you think. It all starts with awareness and developing some benchmarks. Then, it’s developing a plan and sticking to it. If you want to start but are unsure what to do first, please contact Claude Goguen, director of sustainability and technical education, at cgoguen@precast.org or at (317) 582-2328. **PI**

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

RESOURCES:

- 1 energy.gov/eere/amo/industrial-assessment-centers-iacs
- 2 energy.gov/sites/prod/files/2016/11/f34/IAC_Spring_2016_Newsletter_Final.pdf
- 3 “Energy Efficiency Improvement and Cost Saving Opportunities for the Concrete Industry,” December 2011, Katherine Kermeli, Ernst Worrell, Eric Masanet, Energy Analysis Department, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory, University of California, Berkeley, CA 94720

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Aggregates:

A Vital Component of Your Mix Design

Consideration of aggregate's effect on concrete properties is **vital to manufacturing quality** precast products.

By Eric Carleton, P.E.

High-quality concrete mixes depend on a variety of factors. Attention to detail, proper proportioning and thorough quality control are all important, but at the core of the process are the materials used. Aggregate, defined by the American Concrete Institute as “granular material, such as sand, gravel, crushed stone, crushed hydraulic cement concrete, or iron blast-furnace slag, used with a cementing medium to produce either concrete or mortar,” is a vital component of every concrete mix.¹ And with the aggregate composition in a mix constituting approximately 60% to 75% of the volume, employees must take care to ensure that the aggregate used possesses the proper characteristics for a successful end product.

THE IMPORTANCE OF AGGREGATES IN MIX DESIGN

When developing a mix design, the precaster must first determine the required properties of the mix. The precaster may base initial mix proportions for conventional wet-cast concrete on the scientific method detailed in ACI 211.1-91, “Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.”² During this initial design phase, the precaster should consult with aggregate suppliers to ensure that the gradations, shapes and specific gravities of the coarse and fine aggregates selected are available. If the precast products will be installed for department of transportation work, the precaster should also confirm DOT approval of the selected aggregates.

The next step is to run trial batches of the initial mix design with the intent to modify and revise proportions to meet product specifications – including compressive strength, air entrainment, absorption, etc. – and specific production practices such as slump, early strength and surface finish.

When an issue arises during these phases, the manufacturer will often attribute it to the cement, fly ash or admixture used. However, these components are typically governed by strict QC and most times are not the source of the problem. But if the issue can be narrowed down to mixing or batching, the most likely cause will be variation within the aggregates.

When aggregate properties vary from the intended mix design, the concrete can be affected in dramatic ways, altering workability, air content, hardened properties, finish, density and more. And even though the majority of precasters understand the importance of aggregates for concrete strength and durability, failure to meet aggregate testing requirements remains an issue for some.³ As a result, thorough aggregate inspection and testing is necessary for a quality finished product.

INSPECTION IS KEY

QC managers must inspect and verify that the aggregate used complies with the final mix design. This verification process may occur once per day, during delivery, or more frequently based on the precaster’s history with the supplier.

Visual inspection should confirm that aggregate size, shape, coarseness and color is consistent with the final mix design. Precasters should also ensure deleterious material is not introduced into the loads.

A good practice is to pick up aggregate and run it through your fingers. Then, ask yourself, “How dirty are my hands?” Too much dirt will create a weak paste layer around the aggregates in the mix. Additionally, loader operators who charge the batch plant from aggregate stockpiles should avoid contaminating it with the soil where piles are stored.

The QC manager should also verify that the aggregates furnished meet the quality requirements described in ASTM C33 / C33M, “Standard Specification for Concrete Aggregates,” and are within the acceptable limits established for gradation. The precast manufacturer must secure certification that the aggregate supplier has tested the materials and that they are in accordance

with the provisions of ASTM C33 / C33M. If the precaster is an NPCA Certified Plant, it should renew certification at least annually and any time when an aggregate source is changed.

It should be noted that many precast concrete product standards include the text, “Aggregates shall conform to ASTM C33 / C33M, except that the requirements for gradation shall not apply.” This does not mean that the precaster should ignore gradations. Instead, this permits the precaster to optimize mix designs by selecting aggregate gradations and blends outside of those included in the standard.

Consider closely examining your gradations and optimizing to improve economy and performance. Establish acceptable limits for each sieve used within the gradation test. Gradation limits that are too large could significantly alter the characteristics of fresh concrete and the performance of hardened concrete.

TESTING’S ROLE

NPCA Certified Plants should perform gradation testing at least once per 1,500 tons of fine aggregate used, once per 2,000 tons of course aggregate used or once per month, whichever comes first. The plant should conduct these tests in accordance with ASTM C136 / C136M, “Standard Test Method for Sieve Analysis of Fine and Course Aggregates.”

The best means to verify furnished aggregate gradations and to comply to minimum QC testing requirements is to invest in soil sieves, shakers, and scales, and to train staff so that testing can be conducted in house. This provides an opportunity to perform gradation testing at a greater frequency, enabling the development of valuable mix design data for better troubleshooting. It also enhances employees’ knowledge of aggregates, allowing them to better spot variations before they become a larger problem. With a sound technical background, employees can also engage in more fruitful conversations when discussing mixing and batching issues with the aggregate supplier.

PEAK PERFORMANCE

Don’t let a failure to meet aggregate testing requirements prevent your plant from performing at its best. Taking the time to ensure proper inspection and testing procedures are in place will go a long way to improving your mix design and finished products. **PI**

Eric Carleton, P.E., is NPCA’s director of codes and standards. He also is an ASTM Award of Merit recipient and currently serves as vice-chairman of ASTM C13, Concrete Pipe.

RESOURCES:

- 1 American Concrete Institute CT-13, “ACI Concrete Terminology”
- 2 Additional guidance and information on this process can be found in ACI E-1(16), “Aggregates for Concrete,” ACI 221R-96, “Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete,” and the Portland Cement Association’s Design and Control of Concrete Mixes.
- 3 precast.org/2012/11/top-precast-plant-operational-deficiencies-part-1

From Student to Teacher

Tindall Corporation's Joe Sikes is applying knowledge he gained in NPCA's Master Precaster program and teaching critical skills to the company's employees.

By Kirk Stelsel

"I am a firm believer in teaching shop-level employees as much as possible."

– Joe Sikes

Those who hold the Master Precaster designation place a great deal of value in the distinction. It's the culmination of years of classes and testing that are both challenging and insightful. The goal of the program is to pass along the knowledge of those who have spent their lives working in and improving the precast industry to create a better future.

That fact is not lost on Joe Sikes, production supervisor for Tindall Corporation. Sikes earned his gold hardhat, symbolizing his Master Precaster designation, at The Precast Show 2016 in Nashville, Tenn.

"I wanted to expand my knowledge of the precast industry to include all aspects of the process," he said. "I am a firm believer in teaching shop-level employees as much as possible. So the more I know about the process as a whole, the better I can explain and teach those employees."

Like many of his fellow graduates and those currently in the program, the process introduced Sikes to a knowledgeable cast of instructors as well as peers he can now rely on when he has questions or issues. He said it's important to get others' perspectives on how they deal with similar issues to help think outside the norm. It also challenged him and elicited realizations he didn't expect going into the process.

"The technical class is by far the hardest," he said. "It helped me realize that in order to be successful, sometimes you have to step out of your comfort zone – even if it's to do something you really don't like to do. The technical class also helped me gain a better understanding of the engineering side of the industry and what it takes to design different structures."

While challenging in a different and more thought-provoking way, Sikes also appreciated the leadership course and the way his instructor, Greg Chase, presented the

material. In fact, he says he "can't say enough good things" about Chase and the class. It became his favorite for how it will impact his career well into the future and he says he will always remember the lessons.

Going forward, Sikes will carry a number of lessons with him, the most important being what he learned about himself through taking the courses.

"The hard work you have to put in to accomplish a goal comes in many different forms," he said. "During the technical course, I was challenged several times and had to work hard to get through it. The leadership class made me take a step back and evaluate the way I interact and communicate with my employees, my peers and my supervisor.

"I adjusted the way I interview potential employees and incorporated a lot of the things Greg covered in his class."

Sikes says his role at Tindall has expanded since he completed the coursework and he has assumed a much more active role as a teacher. He now focuses on educating Utilities Division employees about what goes into making the products and how to identify and fix potential problems before, during and after the pour. These are essential skills that elevate an employee from simply a person doing a task to a valuable company asset who thinks critically and reacts accordingly.

Asked if he'd recommend the program to others, Sikes didn't mince words.

"If you plan on having a career in the precast industry it is a must," he said. "The knowledge you gain is invaluable. Keep in mind that NPCA has a great support staff and instructors. They want everyone to succeed and will go out of the way to give you additional help." ■

Kirk Stelsel is NPCA's director of communication and marketing.



Joe Sikes,
Tindall
Corporation

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NPCA Foundation

ROUND-UP:

Scholarship Updates, Networking Event

NPCA Staff Report

NEW INTERNSHIP REQUIREMENT FOR UNDERGRADUATE SCHOLARSHIP RECIPIENTS

The NPCA Foundation Board of Directors is excited to announce a new internship requirement for scholarship recipients. Undergraduate students must now complete a minimum of 320 hours each academic year as an intern at an NPCA member company to receive their scholarship payments for years two, three and four. This new requirement will ensure that students who receive NPCAF scholarships graduate with an in-depth knowledge of the precast concrete industry that they can apply in their careers within the industry or as industry influencers.

Applications for the undergraduate and the Daneen S. Barbour graduate scholarships are available at precast.org/ scholarships. Please share this scholarship information with your employees, family and friends, and industry network. **Applications are due March 20, 2017.**

Undergraduate students must now complete a minimum of 320 hours each academic year as an intern at an NPCA member company to receive their scholarship payments for years two, three and four.

CASH FOR CANOES

NPCAF has also developed a new concrete canoe scholarship for students. The NPCAF Board of Directors will again sponsor the American Society of Civil Engineers Concrete Canoe National Competition at the \$5,000 level, and will use an additional \$5,000 to provide up to 10 \$500 scholarships to participating schools. The application is available at precast.org/canoe.

This information has been sent to more than 60 schools that have

recently competed in the competition. If you are aware of any schools that are involved, please send them this information. **Applications are due Jan. 31, 2017.**

NETWORKING EVENT AT THE PRECAST SHOW

The NPCAF Board of Directors will host a professor and student networking event at The Precast Show. This free opportunity will allow students and professors involved in concrete-related areas of study to meet with producers and associates. It's also a great opportunity to talk with students about future employment and internships and meet with professors to discuss opportunities for collaboration. Be sure to join us on the trade show floor on **Friday, March 3, from 3 p.m. to 4 p.m.** All attendees are invited to participate. **PI**



NPCA File Photo

2017 NPCA **WEBINAR** Schedule

DATE	TOPIC	INSTRUCTOR	PRICE
Jan. 19	Department of Labor Overtime Changes: Is Your Business Ready?	Jamie Hasty	\$89 Per Location
Jan. 24, 26, 31*	PQS II – Quality Assurance/Quality Control	Claude Goguen, P.E., LEED AP	\$495 Per Person
Feb. 16	Mixing, Placing & Finishing of Concrete	Evan Gurley	\$89 Per Location
March 16	OSHA's Final Rule on Crystalline Silica: What You Need to Know	Bradford T. Hammock, Attorney at Law	\$89 Per Location
April 13	Tips for Vacuum Testing Septic Tanks	Claude Goguen, P.E., LEED AP	\$89 Per Location
May 18	From Ash to Slag: A Guide to Supplementary Cementitious Materials	Claude Goguen, P.E., LEED AP	\$89 Per Location
June 15	Reducing Concrete Permeability: Does Your Concrete Hold Water?	Kayla Hanson	\$89 Per Location
July 13	Best Practices When Using Fiber Reinforcement	Claude Goguen, P.E., LEED AP	\$89 Per Location
Aug. 17	Troubleshooting Your SCC	Paul Ramsburg	\$89 Per Location
Sept. 14	How to Become the Smartest Person in Your Plant: Calculating the Center of Gravity	Claude Goguen, P.E., LEED AP	\$89 Per Location
Oct. 19	How Your Local Manufacturing Extension Partnership (MEP) Can Help You Pay to Train Your Employees	TBD	\$89 Per Location
Nov. 2	Alternate Types of Cement	Evan Gurley	\$89 Per Location
Nov. 7, 9, 14, 16*	PQS II – Technical**	Claude Goguen, P.E., LEED AP	\$495 Per Person
Dec. 7	Sales and Marketing Alignment: A Key to Revenue Growth	TBD	\$89 Per Location

* Attendance at all sessions is required for PQS II webinars.

** Due to the advanced math concepts covered in PQS II – Technical, students are required to take and pass NPCA's PQS II Technical Math Prep course as a prerequisite for this course. The math prep course is offered as a free webinar to students interested in enrolling in PQS II – Technical. Students must complete the webinar and pass the exam by Tuesday, Oct. 31, to participate in this course.

NPCA conducts **webinars** throughout the year, providing precasters with **vital education** for all facets of running a precast plant.

All webinars begin at noon Eastern.

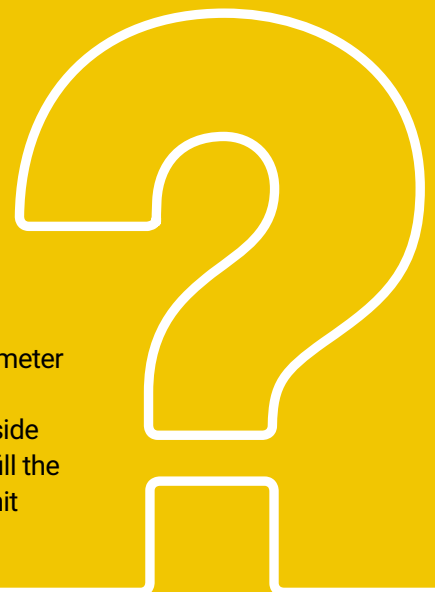
For course descriptions and registration, visit precast.org/2017webinars.

Think you know your stuff?

Prove it by answering the following question. Send your response to Kayla Hanson, technical services engineer, at khanson@precast.org, and if yours is the correct answer (chosen randomly from among all correct answers), you will receive one free admission to one of our 60-minute webinars presented in 2017. We will accept one answer per person. **Good luck!**

CHALLENGE QUESTION:

A form for a round manhole flat slab top is 6 feet in diameter, 12 inches thick and contains a 30-inch diameter round blockout. A total of 90 feet of conventional #6 reinforcing steel was used to make the rebar mat inside of the form. If the total amount of concrete used to fill the form was 3,414.84 pounds, what is the concrete's unit weight?



BOOM TRUCK

Certification Update

Everything you need to know about OSHA's upcoming crane operator certification.

By Evan Gurley



Crane operators must be certified by Nov. 10, 2017.

On Sept. 26, 2014, the U.S. Occupational Safety and Health Administration extended the deadline for crane operator certification requirements in the “Cranes & Derricks in Construction” final rule (29 CFR 1926.1427). The new date for operator certification is Nov. 10, 2017. The rule extends to employers, who must ensure that their operators can safely use a crane.

After OSHA published the final rule, a number of organizations, including the National Precast Concrete Association, raised concerns about the standard's requirement to certify operators by type or by type and capacity of the crane and questioned whether crane operator certification was necessary for the precast concrete industry.

LOOKING BACK

The three-year delay in implementation offered NPCA more time to work with industry crane operator certifying bodies to investigate the development of a boom truck certification appropriate for the precast concrete industry. It also gave plants more time to prepare for the certification.

Before the original 2014 implementation date, NPCA formed a boom truck task force to track and oppose the OSHA certification requirement. After years of discussion with OSHA, the task force concluded that the requirement would be put into effect. As a result, the direction of the task force changed from opposition to education and compliance. This was to ensure that NPCA members would be prepared when the certification requirement went into effect.

With a new direction in hand, the task force proposed the development of a new crane certification that would meet the needs of the majority of the precast industry. Several existing certification exams offered throughout the industry meet the new OSHA requirement, but some NPCA members who have taken the written portion of the existing exams have failed. This is primarily because of the use of larger crane load charts on these exams. NPCA has not seen any systemic failure rates with operators taking the practical exam.

The new exam would include load charts from QMC and USTC cranes, which are widely used in the industry and thus more familiar to operators. Additionally, those working with A-frame rail delivery cranes who don't commonly use load charts would be able to quickly get up to speed.

After several months and many meetings, the NPCA Boom Truck Task Force joined forces with Crane Institute Certification to develop a precast-specific, under 21-ton boom truck certification exam that will address a large percentage of the cranes used in the precast industry. The new certification exam was titled, "Precast Concrete Delivery Truck Crane Certification."

In May 2016, the task force – along with several other NPCA members – met face-to-face with CIC to develop a bank of questions to be used for the written exam. CIC worked with a psychometrician to vet and validate the questions. NPCA then conducted a beta training and testing course in conjunction with CIC as part of the final steps to launch the new exam. This course was held at Shea Concrete Products in Amesbury, Mass., in December 2016.

After beta testing concluded, the new exam was opened to the precast concrete industry for certification of crane operators. Moving forward, to become certified, operators must take two written exams and a practical exam. The written exams include a crane general knowledge exam and the precast-specific exam. Some of the information covered on the general knowledge exam may not specifically relate to the type and size of crane you operate, but is still important to understand. The practical exam must be taken on an under 21-ton boom truck with 36 feet of boom, +/- 5 feet. **PI**

Evan Gurley is a technical services engineer with NPCA.

WHAT'S HAPPENING NOW

NPCA members are welcome to coordinate training and testing courses directly with CIC. We encourage you to work with your regional precast association to coordinate courses and exams in your area. You should also seek opportunities to partner with other local precasters to make the most of your training and testing dollars.

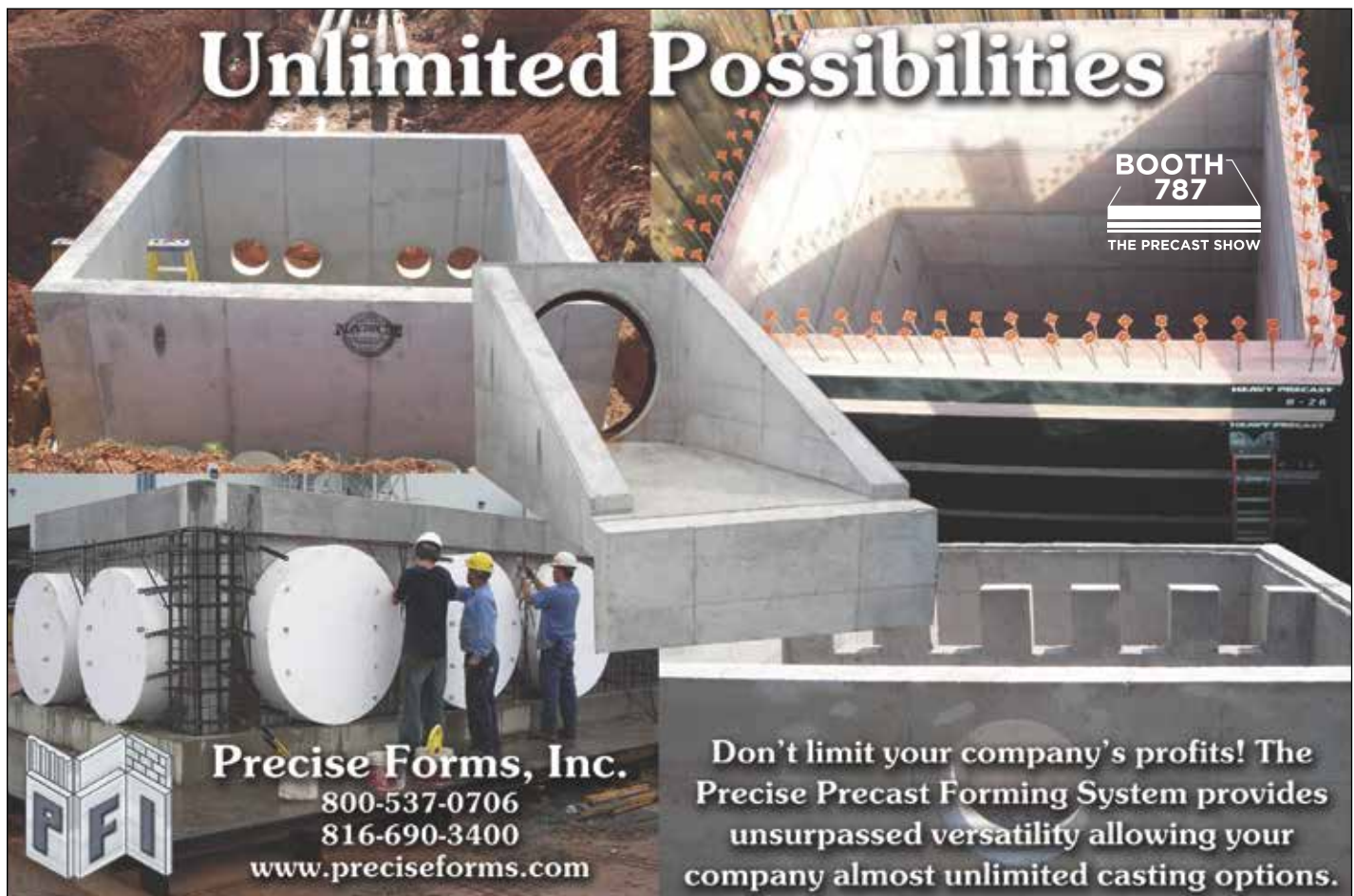
WHAT YOU CAN DO NEXT

With the load chart obstacle removed, there are three key reasons that operators may still struggle with the written exam:

1. Lack of exam prep
2. Literacy challenges
3. Exam anxiety

As owners, you have the opportunity to help your operators overcome these challenges and position them for success.

Check out our exam prep article on page 38 to learn how.



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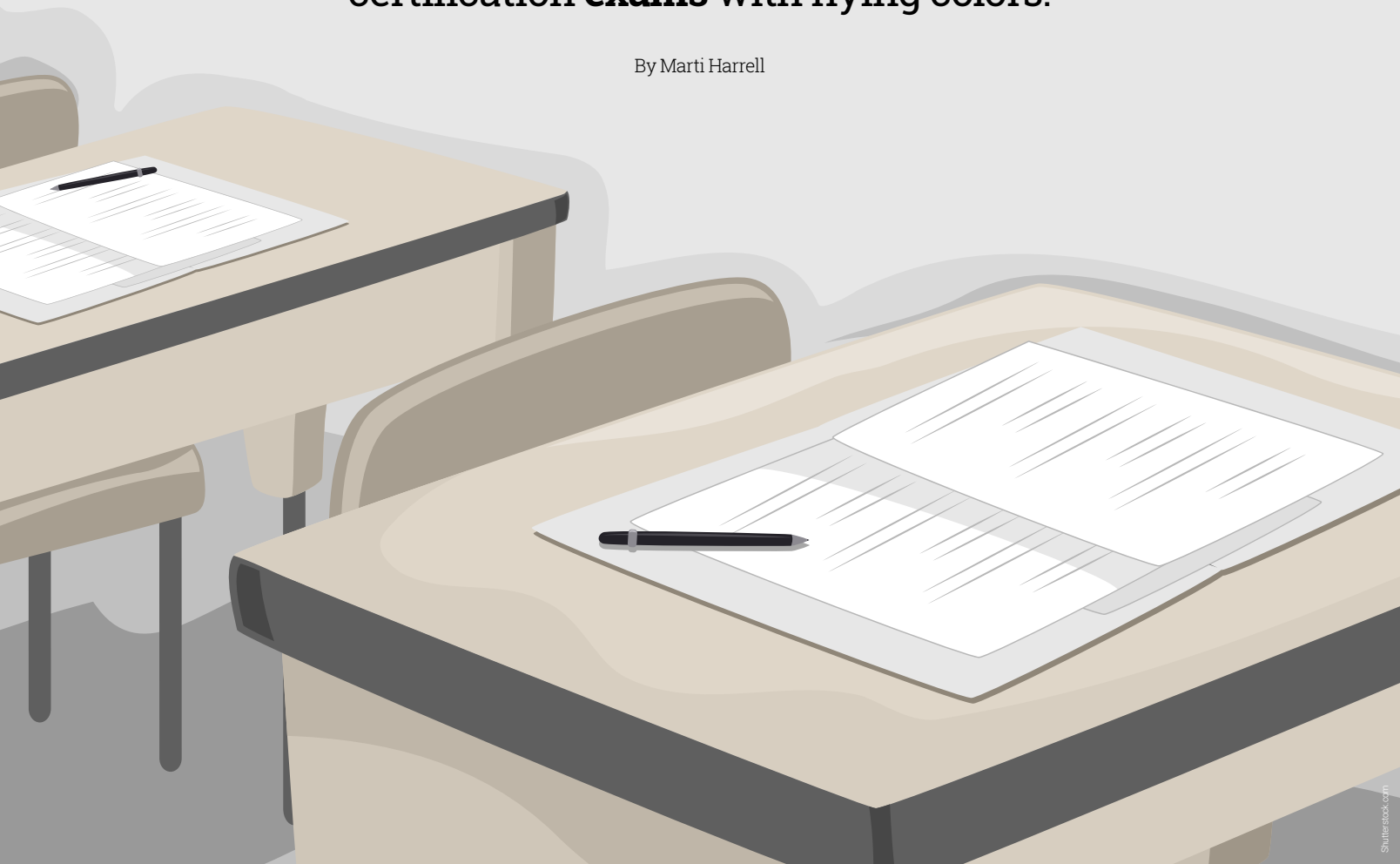
MASTERING

— the —

CRANE OPERATOR CERTIFICATION EXAM

Use these tips to help your company's crane operators **complete** their certification **exams** with flying colors.

By Marti Harrell



The upcoming Occupational Safety and Health Administration crane operator certification requirements mean that capable, safe and knowledgeable operators will have to take written exams for the first time in a long time. This can be a nerve-racking experience, especially for those who haven't been in school for many years. Luckily, there are a number of techniques you can share with your operators to help alleviate the stresses associated with test-taking.

A major source of exam anxiety is fear of the unknown. Much like going to the dentist, the anticipation of what could happen can be much worse than the actual procedure. The first step in helping your crane operators overcome their exam anxiety is to ensure they know what to expect.

KNOW THE MATERIAL

Understanding what types of questions will be asked on the exam is key. There are many resources available from OSHA and third parties to help your operators prepare. Live and online prep courses, study guides, books and even your crane manufacturer are all great resources for helping your operators learn the material that will be covered. It's important to remember that there's no shortcut to studying. Providing your operators the resources and the time needed to study is essential.

In addition to prep courses and study guides, consider creating a study group for your operators. A weekly, hour-long study group during lunch or at the end of the workday is a great way to keep everyone moving through preparation. To help facilitate learning, consider asking each operator to teach the others about one small section of the material. Knowing they have to explain their sections to others will help motivate operators to understand the information.

ADDRESS LITERACY AND LEARNING BARRIERS HEAD ON

Some of your operators may have decades of experience operating cranes safely and effectively, but they may also have language barriers that will need to be addressed to help ensure success on the exams.

Consider referring operators with literacy challenges to your local library or literacy center. Many of these organizations offer free classes to adults who want to improve their reading and writing skills. For operators with learning barriers – including any learning disabilities – speak with your human resources department to determine if the disability is covered under the Americans with

Disabilities Act. If so, the organizations offering the crane certification exams are required to provide reasonable accommodations for the test-taker.

Talking with your operator about a perceived literacy or learning challenge can be difficult. But failing to address these issues can set your operator up for failure on the exam. Having an open discussion about challenges helps determine if the time, money and resources you plan to invest will be well-spent.

When evaluating your operators' literacy skills, don't forget about their computer literacy. Most of the certification exams are administered on a computer. Some seasoned crane operators may have limited or no experience with computers. Help these operators by having them spend 15 minutes per day on a spare computer in your office. Have them perform simple tasks or task a coworker with walking them through the basics.

PRACTICE, PRACTICE, PRACTICE

Fear of the unknown means test-taking can cause high levels of stress. Help your operators combat their nervous feelings with plenty of practice.

If you've deployed study groups, include a 10-minute exam each week that replicates the full exam experience. Have your operators take a timed written exam covering that week's study material in a quiet room. When they are done, grade it and then review the results. Going through the test-taking process repeatedly will help your operators become familiar with what to expect on exam day. Reviewing the exam as a group also gives your operators an opportunity to see the correct answers and to ask any questions they may have.

Operators with computer literacy issues can take practice exams on a computer. Create a simple Microsoft Word document with 10 multiple choice questions on the study material for that week. Then, have the operator highlight the right answer in color or enlarge the font. This gives your operators additional practice using a computer while also helping them feel more confident heading into the exam.

PREPARATION IS KEY

Taking the time to prepare your crane operators will give them the best chance to succeed and create a true sense of accomplishment when they pass the exam. **PI**

Marti Harrell is NPCA's vice president of technical services and professional development.



EXTRA TIPS FOR OPERATOR SUCCESS

- ✓ **Use relaxation techniques** (deep breathing, relaxing your muscles one at a time, etc.)
- ✓ **Get ample rest** before taking the exam
- ✓ **Talk to the instructors** about your concerns
- ✓ **Visit the testing center** in advance
- ✓ **Make a study schedule** and stick to it

REMEMBER:

Everyone wants you to do well – you can do this!

PRECAST FORECAST

Moderate Growth Ahead in



NPCA Staff Report

While much has changed in Washington D.C., for now, much remains the same with regard to the construction industry. And for the precast concrete sector in 2017, that's not bad news. The fundamentals are in place for a return to moderate growth next year after what appears to be a fairly flat year in the construction industry in 2016.

While 2017 could be a fairly normal year, beyond that the picture quickly grows complicated. Precasters – and the entire construction industry – would certainly benefit from a massive public works bill to rebuild the country's aging infrastructure. But for the 2017 forecast, we are assuming that any work would come in 2018 at the earliest. Based on comments from both sides of the aisle, Congress may be open to a bipartisan bill that would help break the gridlock – and an infrastructure bill would be something that members of both parties could get behind. However, there are still a large number of fiscal conservatives in Congress who don't believe the country should be spending additional money on infrastructure right now. And the leaders in the House and Senate have made it known that an infrastructure bill, while important, is not a top priority.

HOW TO PAY FOR IT

The new administration and Congress may be talking a lot about infrastructure in the first half of 2017, but the nuts and bolts of

crafting a bill and agreeing on how to pay for it will take time. It may be years before a bill is passed, projects are designed and bid, and contractors are ordering precast from your plant.

That may be a topic for Precast Forecast 2018. But in 2017, NPCA is forecasting a modest 2% to 3% increase in revenue for the precast concrete industry, which we define as all precast elements, prestressed concrete, reinforced pipe, architectural precast and the broad category of "other." Using this global definition of the scope of the industry and data from the annual NPCA Benchmarking Report, we expect total precast sales to grow from a projected \$23.3 billion in 2016 to nearing the \$24 billion figure for 2017.

If that forecast holds true, it would be the sixth-straight year of growth after the precast industry lost about 40% of its sales volume during the Great Recession. Recovery to the \$24 billion range would put the industry at about 87% of the high water mark, which occurred in 2007 with \$27.5 billion in sales.

"The opportunities look quite positive for continued growth in the coming years," said Ty Gable, NPCA president. "Next year we could see more of a continuation of the orderly growth we've had the last several years."

FAST ACT HITS THE STREET

Optimism stems from a few key areas but is tempered by late-year budget maneuvers by Congress. When Congress passed the "Fixing America's Surface Transportation Act" in late 2015,

it authorized \$305 billion over five years for transportation infrastructure planning and investment. The FAST Act guaranteed a five-year funding window that triggered large highway projects which are now just getting started. According to Gable, the effects will begin to be fully realized in 2017.

“It takes a solid year before that type of funding actually makes its way to the construction site,” he said. “The FAST Act didn’t help much in 2016, but we’ll definitely see the benefits in 2017 and beyond.”

But it may not happen right away. As of mid-December, FAST Act funding increases passed last year were not included in the continuing resolution to fund the government through the end of April 2017. That means projects that could have started now would be on hold – at least through the first four months of the year.

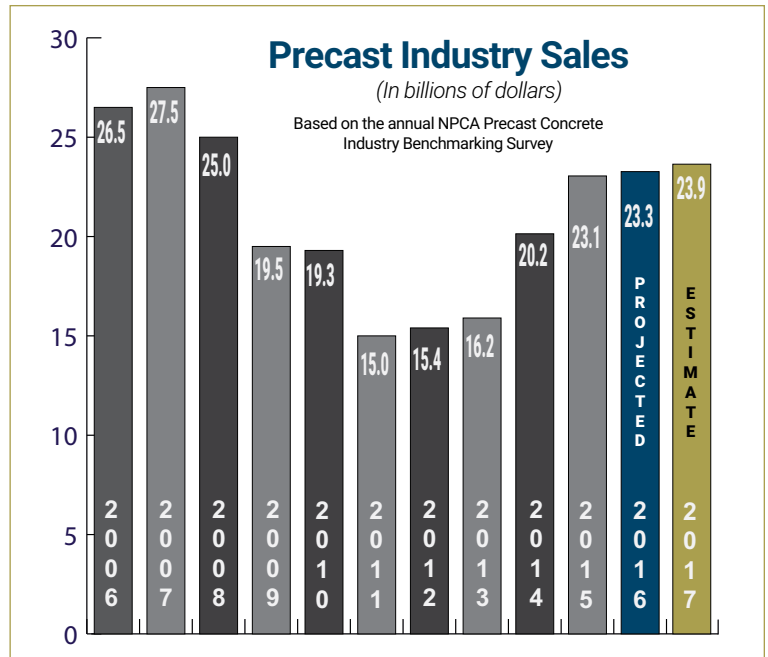
As of mid-December, though, prospects still looked good for passage of the Water Resources Defense Act, a bill that includes funding to repair failing water and wastewater infrastructure, with projects administered by the U.S. Army Corps of Engineers. WRDA funding would create a wide scope of projects throughout the country that will result in a host of opportunities for the precast industry, although most of the activity would likely come in 2018 and beyond.

A host of local transportation ballot measures also passed in the fall elections, creating additional long-term opportunities for precasters. The American Road and Transportation Builders Association tracked 280 transportation funding ballot measures in the 2016 election, 69% of which were passed. ARTBA estimates the additional investment at \$201 billion in the coming years. By far the largest investment came from California voters, who approved \$133 billion in transportation ballot measures. That includes a 40-year, \$120 billion measure to fund local road, bridge and transit projects through a 1 cent sales tax in Los Angeles, according to ARTBA.

ACROSS-THE-BOARD INCREASES

The NPCA Benchmarking Report divides the precast concrete industry into six major product groups: building and landscaping, sanitary and stormwater, transportation, utility and industrial, water and wastewater, and other. Sales increased in every product group between 2014 and 2015. Total revenue was expected to hold steady or rise slightly in 2016.

“In 2017, we had anticipated a sizable bump in transportation products – somewhere in the 5% to 7% range,” Gable said. “The delay in FAST Act funding will probably decrease that estimate by a few percentage points. We also expect revenue to increase in the other product groups at a similarly modest level of 2% to 3%.” **PI**



NPCA is forecasting a modest 2% to 3% increase in revenue in the precast industry for 2017.

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People & Products

People & Products is a forum where NPCA members and nonprofit organizations can share information on new products, personnel promotions, acquisitions or service announcements concerning the precast concrete industry. Items are printed on a space-available basis.

For possible inclusion, send your press releases and photos to sgeer@precast.org.

NEW CROSSTAB UNITS AVAILABLE FROM NORTH AMERICAN LIFTING EQUIPMENT

North American Lifting Equipment has new Effer Crosstab units available. The Crosstab System, which provides a variety of advantages for crane operators including increased stability, greater overall reach and enhanced flexibility, was first introduced to the precast concrete industry in 2015.



Effer Crosstab Unit

SPILLMAN COMPANY COMPLETES CUSTOM MOLD PROJECTS

Over the past few months, Spillman Company has manufactured many custom molds tailored to meet the needs of specialized projects. These include air traffic control forms for a Federal Aviation Administration control tower, Gravix forms for a proprietary wall system and flat casting tables and casting beds for a 30-foot-long, 15-foot-wide freestanding casting table.

Learn more about these and other custom projects at spillmanform.com.



Spillman's Gravix forms



GCC ACQUIRES MULTIPLE CEMEX OPERATIONS

Grupo Cementos de Chihuahua announced the

acquisition of multiple CEMEX operations in Texas and New Mexico. With the addition of these locations, GCC will now employ nearly 3,500 workers.

“This acquisition is a significant step forward in our sustainable growth strategy,” said Enrique Escalante, CEO. “With these assets and the new employees who will join the company, we will strengthen our competitive advantage, increase our portfolio of products and improve our operations by sharing best practices.”

BHS-SONTHOFEN HIRES NEW MIXING SALES MANAGER

BHS-Sonthofen recently appointed Mike Kerins as the company's new mixing sales manager. Kerins has more than 10 years of experience in the industry and has previously worked with CEMEX and Paverstone.

Kerins holds certifications from NCDOT, SCDOT and a variety of industry organizations.

In his new role, Kerins will oversee the increased stocking of mixers and spare parts in the company's Charlotte, N.C., facility to allow for fast deliveries and immediate customer service.



Mike Kerins

BASF RECEIVES CERTIFICATION FOR LEED V4-COMPLIANT MANUFACTURER INVENTORY REPORTS

Thanks to a recent third-party audit, BASF's Construction Chemicals and Performance Materials divisions in North America can now provide LEED v4-compliant Manufacturer Inventory Reports that satisfy requirements for Building Product Disclosure and Optimizations – Material Ingredients, Option 1.

“This certification provides architects, designers and LEED project teams with the information needed to make educated decisions regarding the products they use in the design and execution of structures,” said David Green, sustainability analyst.

Reports are available for chemical admixtures, waterproofing and sealants, concrete repair and protection systems, underground construction products and more. **PI**

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CALENDAR OF Events



March 2-4, 2017
THE PRECAST SHOW 2017
Cleveland Convention Center
Cleveland, Ohio



Oct. 12-14, 2017
NPCA 52ND ANNUAL CONVENTION
Loews Atlanta Hotel
Atlanta, Ga.



Feb. 22-24, 2018
THE PRECAST SHOW 2018
Colorado Convention Center
Denver, Colo.



Oct. 4-6, 2018
NPCA 53RD ANNUAL CONVENTION
Omni Providence Hotel
Providence, R.I.



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