MAY/JUNE 2013

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PRECAST ABROAD

INTERNATIONAL PRECAST PROJECTS IN THE NEWS

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- Rainwater: You and the EPA
- Variability Part 2: Measure it, Track it
- Make Intelligent Choices for a New Plant or Add-on

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Anticipating Heavy Construction Season with Caution

BY MIMI RAINERO COLES | *Chairman, National Precast Concrete Association*

As spring begins to sweep across the country and we eagerly look ahead to the 2013 heavy construction season, there are encouraging signs that point to a precast concrete industry that is slowly moving forward. After a couple of years spinning our wheels at the bottom of the recession, we're finally getting some traction and seeing more opportunities for work coming our way. While it may be next year before the momentum takes hold, there *are* more bidding opportunities out there this year. And while that is good news, it should be tempered with a word of caution.

In the enthusiasm to bid new work in the post-recession environment – maybe from contractors or regulatory agencies you're unfamiliar with – it's a good idea to carefully review the bid specs and read all the fine print so you know exactly what the contract documents require. As the saying goes, "Haste makes waste!" Moving too fast may cause you to miss an important detail. Nobody wants surprises!

Obviously. But there have been incidents where precasters have not given an RFP the usual eagle eye, and have been stuck by a little detail that ended up costing a lot of time and money.

In one case, the contractor wanted the precast pieces delivered to the site just in time for installation, and it was stated in the bid. In his haste, the precaster missed that detail and after he signed the contract and started producing the precast, he learned that he would not be able to store or stage product at the site.

Instead, he had to find storage space for the pieces until they were requested. Because he didn't have free space on his yard he ended up paying for rental space, absorbing the additional cost of loading, hauling and unloading the precast pieces in an off-site location. Then he had to reload and deliver to the jobsite!

While you might think "rookie mistake," it may have been the precaster's enthusiasm for new work after a long dry spell that glazed over his eyes and caused him to miss that very important detail.

Site logistics also need careful consideration before finalizing transportation costs to a project. Load requirements for bridges to be crossed, height requirements for bridges to be driven under, proper space for trucks to stage or turn around, and knowing if your trucks may have to back into a project site are all important factors in delivering a successful project on time and efficiently. What may seem a fairly routine installation can quickly become a complicated procedure that can tie up trucks and crew for much longer than the expected time.

It's also smart to check for new language when you're looking at what may seem like a fairly routine RFP. Many jurisdictions have recently begun to specify "Buy American" provisions in response to stepped-up enforcement by the federal government. It could make a big difference in your costs and additional labor associated with segregating and tracking your materials. Not paying attention to issues like these can mean the difference between profit and loss in an industry with razor-thin margins.

There are growing opportunities in the marketplace, and that's good news for all of us. But if you're an owner or a decision maker in a precast concrete plant, you are responsible for the fiscal health of the business, and it always makes sense to watch for those little details that can quickly become profit killers *after* you win the job.

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PROFILE

Precast Abroad

The Flat Iron Building in Stockholm mimics the name and shape of the New York City structure – except the Swedish version is made of precast concrete exterior panels, interior panels and hollow-core slabs. Take a tour of some of the most amazing projects in other parts of the world that are using precast construction.

Story by Kirk Stelsel; photo by Torbjörn Persson

DEPARTMENTS

What's inside

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FEATURES

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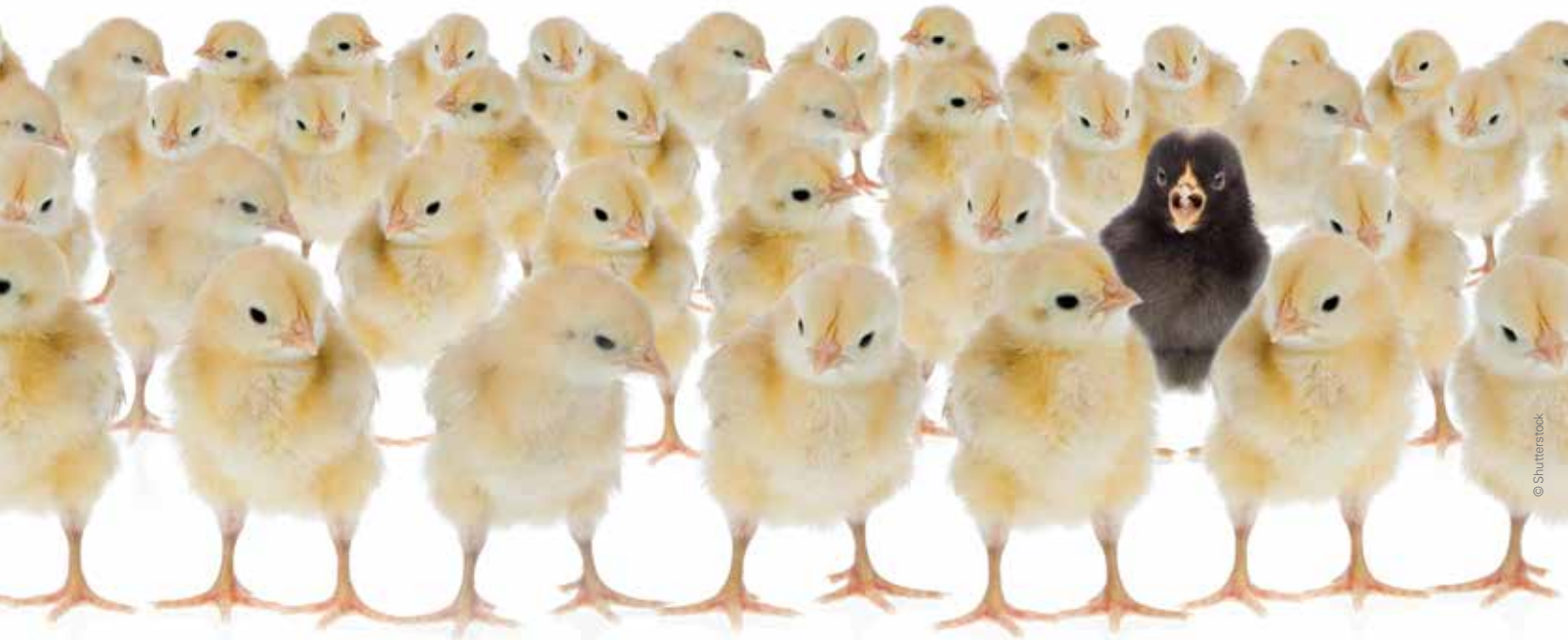

Variability PART 2

Ways to measure and track variability.

BY CLAUDE GOGUEN, P.E., LEED AP

In the last issue of *Precast Inc.*[1], we talked about the concept of variability and how a good quality control program should include measures to ensure consistency in your product. Now think of how you view your suppliers. You want them to be reliable. You want to expect a level of service and quality of product, and they must meet or exceed those expectations. In other words, you want to trust your suppliers. Your customers are expecting the same of you: consistent, high-quality products made to their exact specifications.

Let's focus on that word "consistency." To achieve consistency, we must minimize variability, and to do that, we need to obtain consistent testing results. The first step in tightening those results is to be aware of the disparity in the first place. We will look at some ways to measure and track variability that will enable you to better detect any issues.

Averages don't tell us everything

When you think of concrete quality, you'll likely conjure up an image of a concrete cylinder. After all, the compression test is one of the most important in the QC process. Let's say we break a cylinder, and the strength we get is 4,850 psi. The next cylinder breaks at 4,970 psi. Now that we have two values, we can compute the average, which in this case is 4,910 psi.

But that really doesn't give us a lot to go on. Averages don't tell everything we need to know. Case in point: The average depth of the Mississippi River is 11 in. That average doesn't help the guy running a barge with a 9-ft draft. He's more concerned about the depth where he'll actually be traveling.

This is where we introduce frequency distributions and standard deviations. These will provide a measurement to evaluate the consistency of your test results. Standard deviations are a broad measure of quality in your production operation and will provide a clear sign if changes are necessary. There are two basic types of variation:

- **Common variation** – Inherent in every process describing why nothing is ever exactly the same.
- **Special variation** – Something happens that is not usually part of the process.

The use of standard deviations allows identification of special variations, enabling them to be controlled without overreacting to common variability. In the case of strengths, for example, by continually monitoring your 28-day strength test results and evaluating the standard deviations with each mix, you can determine whether you can reduce costs or improve strengths, or need to redesign a mix altogether. Cost savings may result from reducing the amount of cement or by eliminating product rejections caused by low strengths. Both are dependent on the degree of control you have over your mixes.

There will always be *some* variation in the strengths you achieve. It's practically impossible to get the same compressive strength test after test. What you're primarily concerned with is always meeting or surpassing the *specified* 28-day compressive strength, which we will refer to as f_c. In order to do that, you will have to work with a mix designed to deliver a higher concrete strength. This higher strength is called the required average compressive strength, and we will refer to as f_{cr}. You must choose an f_{cr} that will ensure all your products achieve the specified strength (or greater). Obviously you cannot do this without knowing exactly how much your strengths vary.

Therefore, the standard deviation is needed to determine f_{cr}. As you reduce your degree of variation (through the controls we discussed in Part 1 of this series), the less the f_{cr} needs to be, and that translates to a cost savings for the company.

Formulas and definitions

Normally, you should have at least 30 consecutive tests or two groups of consecutive tests totaling 30 tests or more. With this number of tests, a result is the average of any two cylinder breaks from the same sample. Later on, we will discuss how to proceed if only 15 to 29 consecutive tests are available, or if no data are available to establish a standard deviation.

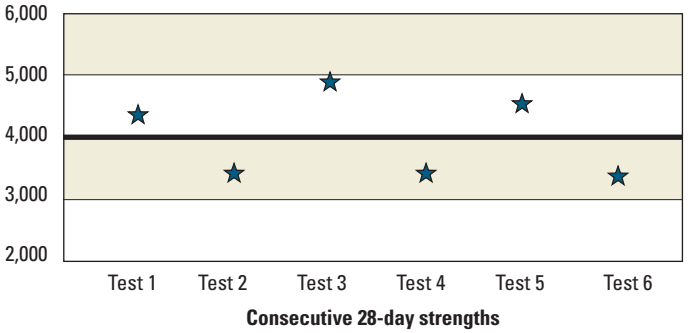

FIGURE 1.

Figure 1 illustrates several fundamental statistical concepts. In this abbreviated example, six consecutive 28-day strength test results have been graphed for one particular mix. The heavy horizontal line is the average strength of all six tests. In statistical language, this is identified as $\boldsymbol{X}$ (mean or average). Figure the average by adding all the test values and dividing by the number of test results, $\boldsymbol{N}$:

$$\boldsymbol{X} = \frac{(4{,}300 + 3{,}500 + 4{,}900 + 3{,}600 + 4{,}400 + 3{,}300)}{6} = 4{,}000 \text{ psi}$$

But if you have a 4,000 psi specification requirement, three of these tests did not meet the required strength. They might represent product cast on three different days or even at different times during the same day.

It is useful to have a single value represent the spread of these numbers above and below the average. If we take the difference between each individual test and the average, without regard to whether they are above or below average, then add them up and divide by the total number of differences, $\boldsymbol{N}$, the result is the *mean deviation*.

$$\boldsymbol{N} = \frac{(300+500+900+400+400+700)}{6} = 533 \text{ psi}$$

The *mean deviation* is one measure of variability. The smaller

the value of ***N*** – and the smaller the variance of each test from the average, ***X*** – the better your group of numbers. But you should also know that one or two large differences in a group of tests will have a significant impact on the mean deviation. Those large differences are disturbing, because they indicate that some individual tests are not really indicative of the whole group. Perhaps someone forgot to handle a cylinder properly and left it to dry out in the sun all day. Obviously, the strength result of *that* cylinder would stand out – it would be an "outlier."

A *standard deviation* seeks to emphasize the impact of very low or very high test values, or outliers. To do this, we apply a simple mathematical concept: Square the differences before adding them together, then divide by (***N***-1), one less than the total number of samples. The square root of this value is known as the standard deviation. This measure of variability, the standard deviation, is normally written as the letter ***s***. The mathematical formula for standard deviation is:

$$S = \sqrt{\frac{\Sigma\ (Xi - X)^2}{(n - 1)}}$$

where ***s*** = standard deviation in psi
Σ = summation of
n = N = number of tests
Xi = each individual test in psi
X = average strength in psi

Expanding this formula, the standard deviation of the tests given in the previous example would be:

$$S = \sqrt{\frac{(X_1 - X)^2 + (X_2 - X)^2 + (X_3 - X)^2 + (X_4 - X)^2 + (X_5 - X)^2 + (X_6 - X)^2}{(6 - 1)}}$$

The equations in this article can be calculated with a typical hand-held business or scientific calculator, and the answers will magically appear. But for the sake of explanation, here are the calculations by hand:

i	X	X - X	$(X-X)^2$
1	4,300	4300 - 4000 = 300	90,000
2	3,500	3500 - 4000 = -500	250,000
3	4,900	4900 - 4000 = 900	810,000
4	3,600	3600 - 4000 = -400	160,000
5	4,400	4400 - 4000 = 400	160,000
6	3,300	3300 - 4000 = -700	490,000
Σ	24,000		1,960,000

$$S = \sqrt{\frac{1{,}960{,}000}{5}} = 626 \text{ psi}$$

Is this considered good or bad? Here are some threshold values published by AC 318-11:

3,000 to 4,000 psi concrete	Quality Control	> 10,000 psi concrete
s		***s***
Standard Deviation		Standard Deviation
300 to 400 psi	Excellent	300 to 500 psi
400 to 500 psi	Good	500 to 700 psi
500 to 600 psi	Fair	
> 600 psi	Poor	> 700 psi

Besides being an indicator of your quality control, the standard deviation can determine f_{cr}, the required average strength. As required by ACI 318-11, two formulas are used when at least 30 tests are available. You must choose the larger f_{cr} from the following calculations for specified concrete strengths of 5,000 psi or less:

$$f_{cr} = f_c + 1.34\ s$$
$$f_{cr} = f_c + 2.33\ s - 500$$

Continue with the example above, where the standard deviation was calculated as 626 psi. If you are looking for a specified 28-day strength, f_c, or 4,000 psi, your required strength (f_{cr}) should be the larger result of the two formulas:

$$f_{cr} = 4{,}000 + (1.34 \times 626) = 4{,}839 \text{ psi}$$
$$\text{or } f_{cr} = 4{,}000 + (2.33 \times 626) - 500 = 4{,}959 \text{ psi}$$

Thus, in this scenario you should aim at producing 4,959 psi concrete, or more practically 5,000 psi concrete, in order to ensure that all of your breaks will be at least the specified 4,000 psi.

Now let's look at two sets of consecutive test records that total at least 30 tests (on concrete made with similar materials, QC procedures and operating conditions). The standard deviation is the statistical average of the values calculated from each test record. The following formula provides the statistical average deviation, ***s***, of the values calculated from each test record:

$$S = \sqrt{\frac{(n_1 - 1)(s_1)^2 + (n_2 - 1)(s_2)^2}{(n_1 + n_2 - 2)}}$$

where n_1 = number of samples in group 1,
n_2 = number of samples in group 2, and
s_1 and s_2 are calculated with the formula above for 30 tests

When the number of tests is between 15 and 30, multiply the standard deviation calculated by the above formula with the appropriate number from the ACI 318 table in Figure 2.

Finally, if you do not have sufficient test records for calculating a standard deviation, you will need to work up a mix for a new specification. Once again, ACI has a table for that. Determine the required average strength from ACI 318, Table 5.3.2.2 (see Figure 3), select mix proportions that will achieve the required average strength, and make trial mixes and/or several field tests.

As you work diligently to reduce variation in your test results, your standard deviation result will decrease as shown in Figure 4. The standard deviation of the green curve is 100 psi. The standard deviation of the blue curve is 45 psi. This means in order to hit a specified flexural strength of 580 psi, the mix design associated with the green curve will have to be designed for 810 psi simply because of its large variability. The mix design associated with the blue curve, however, can be designed for 680 psi – 16% less – because of its lower variability.

Table 5.3.2.1 – Modification Factor for Sample Standard Deviation When Less than 30 Tests are Available

Number of tests*	Modification factor for sample standard deviation†
Less than 15	Use Table 5.3.2.2
15	1.16
20	1.08
25	1.03
30 or more	1.00

*Interpolate for itermediate number of tests.
†Modified sample standard deviation, ss, to be used to determine required average strength, f_{cr}, from 5.3.2.1

FIGURE 2.

Table 5.3.2.1 – Required Average Compressive Strength When Data are Not Available to Establish a Sample Standard Deviation

Specified compressive strength, psi	Required average compressive strength, psi
$f_c < 3000$	$f_{cr} = f_c + 1000$
$3000 \le f_c \le 5000$	$f_{cr} = f_c + 1200$
$f_c < 5000$	$f_{cr} = 1.10\, f_c + 700$

FIGURE 3.

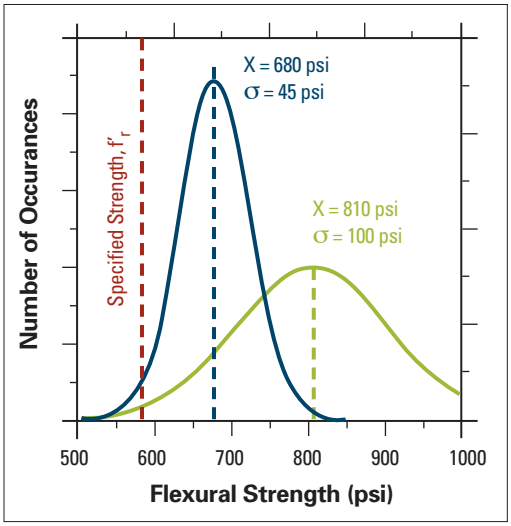

FIGURE 4.

Conclusion

Knowing how much variation you have in your test results can be quite an eye-opener. It can be the first step toward taking control of certain factors to tighten up your tolerances. While standard deviation calculations can be a great tool, it's not the only way to control variability. You can simply plot results on graph paper to give you a baseline. Use whatever works for you and your resources at hand.

A good quality control system encompasses three parts: Say what you do, do what you say, and prove it. Anyone can have a shelf of manuals and procedures laying out their QC program. Those who rise above will work on the second part by creating a quality culture that always strives to enhance consistency. Being aware of your variability is Step 1. Take the time to plot your results and see how you are currently faring. This will set a baseline to measure improvement. Document these measures and record them. Your customers will appreciate your efforts.

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

[1] See the March-April 2013 issue of *Precast Inc.* for "Variability – Part 1" or visit precast.org/publications for the digital version.


NPCA file photo

Plant Stormwater Permits & EPA's Increasing Authority

How well does precast concrete plant effluent meet EPA's NPDES permit regulations?

BY SUE McCRAVEN

If it rains where you work, you need to know about the National Pollutant Discharge Elimination System (NPDES). The same goes for anyone who discharges process water from his or her manufacturing operations. Because all precasters use potable water to make concrete, each plant must make sure it is NPDES-compliant (plants that discharge directly to municipal sanitary sewer systems do not require NPDES permits).

NPDES's function is to protect surface waters from water-borne industry pollutants through the enforcement of effluent limits. Most NPDES permits are administered by state environmental agencies.

Why should you care?

Why should a precast concrete producer care about how rainwater flows in the yard or where plant process water ends up?

- There are significant U.S. Environmental Protection Agency (EPA) fines for violations of NPDES, created through a 1972 amendment to the Federal Water Pollution Control Act.
- Concrete manufacturing facilities are identified under NAICS 327390 (SIC[1] 3272) as an industry that must meet NPDES compliance. There is no ambiguity in the law about the producer's responsibilities.
- The Clean Air Act authorized the EPA to enforce NPDES, and EPA's province has grown.
- Most of us know that in the last five years the EPA has been given greater authority to enforce more stringent and expansive interpretations of existing statutes. New, tougher air and water quality regulations can be expected across all industries.
- Most states enforce their own versions of NPDES (some include groundwater pollution) and can promulgate water quality regulations that are even more onerous and restrictive than federal standards.
- Once stormwater mixes with a plant's process water, it is categorized as process water and must meet strict pollutant limits with significant monetary penalties for noncompliance.

"Fishable, Swimmable"

U. S. concrete manufacturing facilities cannot pollute navigable waters under NPDES. If "navigable" makes you think only of large tankers on the Mississippi River or the Great

Lakes, you might be off the mark. In addition to commercial shipping waterways, "navigable" means any surface water – like lakes and streams – but the term legally encompasses any body of water that can be used for "recreation" or is home to fish and aquatic life. So you might dismiss a narrow, shallow and garbage-strewn drainage channel near your business, but if it contains aquatic organisms or children play in its waters, it qualifies under NPDES. When we think of "navigable" or "surface waters" we need to think of "fishable, swimmable" and recreational possibilities.

Under NPDES language, a precast concrete plant is a "point source" for water pollution. Permits require that plants establish a stormwater pollution prevention plan that incorporates best available management practices.

How the EPA looks at precast's six primary pollutants

Precasters are relatively lucky in the arena of environmental law. Precast concrete production crews don't work with really nasty chemicals or lots of hazardous substances (though wet concrete is considered hazardous to skin) that are common in other manufacturing sectors. But there are six potential water-polluting substances from concrete production that are of concern to the EPA:

1. Oil and grease: 10 mg/L daily maximum
2. pH level: between 6 and 9
3. Iron: 1 mg/L daily maximum
4. Total Suspended Solids (TSS): 50 mg/L daily maximum
5. Total Dissolved Solids (TDS)
6. Chemical oxygen demand: 30 mg/L monthly average

To get an idea of typical pollutant discharges in the precast industry, Table 1 provides the results from two years of monitoring pH and TSS levels at 15 precast concrete plants.[2]

EPA's effluent limitation guidelines for concrete manufacturing facilities, using the best practicable control technologies that are currently available (BPTs), are:

- TSS: Not to exceed 50 mg/L
- pH: Within the range 6.0 to 9.0 su

You can see that, when all 15 plants are assessed together, the table's mean value for these two pollutants met EPA's BPT limit guidelines for one monitoring period (highlighted in red) and that there exists a broad range of pH and TSS discharge values among producers. It is likely that these data are representative of precast concrete plants in general.

Control, recycle and eliminate site drainage

Precasters are encouraged to do the following:

1. Control site drainage (waters associated with washout; dust-control; manufacturing; maintenance for mixers, vehicles, formwork and equipment; and yard products and materials exposed to rainwater)
2. Recycle manufacturing process water and byproducts
3. Treat process water to meet effluent discharge limits
4. Monitor pollutant limits
5. Apply for applicable state permits or certificates of coverage (COCs) for stormwater and process water

There are many strategies for precast manufacturers to control and prevent water pollution. Articles published by the National Precast Concrete Association provide additional information on NPDES and process water issues.[3]

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

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[1] In 2000, the North American Industry Classification System (NAICS) began to replace the U.S. SIC system in N. America and Mexico. The U.S. Standard Industrial Classification (SIC) system was the older way of classifying businesses in North America.

[2] "Fact Sheet for the Draft Renewal of the Concrete Products Manufacturing Facilities General Permit (NJ0108456)," The New Jersey Department of Environmental Protection, 2008.

[3] See these NPCA articles: "How to Prepare for and Survive Environmental Inspections" in the July-August 2012 issue, "Muddy Waters" in the September-October 2012 issue, and "Hazardous Materials Reporting" and "Process Water" in the January-February 2013 issue of *Precast Inc.* magazine.

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	TSS	pH	TSS	pH	TSS	pH	TSS	pH	TSS	pH	TSS	pH	TSS	pH	TSS	pH
1	5	7.7	5	8.2	10	8.2	8	7.2	90	8.9	12	7.6	3	7.2	24	8.2
2	341	11.9	--	--	132	10.9	228	10.1	--	--	<1	7.3	103	9.4	83	8.1
3	2416	9.4	<1	4.9	6	5.0	6	5.0	<1	4.7	2	4.9	<1	4.6	2	5.7
4	353	11.4	174	11.6	--	--	123	10.9	140	8.5	158	12.6	79	11.8	64	12.3
5	4	8.1	36	6.9	14	7.1	46	10.1	14	6.8	--	--	14	7.0	6	7.9
6	21	6.2	20	6.3	3	6.0	3	7.3	37	6.8	<1	6.5	2	7.2	<1	7.2
7	335	10.8	85	9.1	4	7.6	2	7.1	66	7.3	<1	7.1	20	8.6	60	7.4
8	193	11.1	550	9.6	170	9.5	1	6.8	379	12.3	<1	6.6	8	7.5	<1	7.0
9	333	9.0	14	7.4	--	--	34	8.2	11	7.7	18	7.4	19	9.6	<1	6.9
10	15	9.6	2	7.9	26	7.7	<1	7.1	45	11.9	<1	8.9	62	11.9	<1	7.5
11	5	6.6	--	--	1	6.4	<1	7.1	<1	7.1	6	6.9	<1	6.7	<1	6.9
12	17	7.7	--	--	129	9.0	--	--	--	--	47	6.9	21	10.0	--	--
13	516	11.9	98	11.6	126	11.5	74	9.7	148	9.7	--	--	272	9.8	22	10.4
14	747	9.7	--	--	584	8.9	--	--	69	9.5	--	--	46	9.7	102	9.0
15	356	9.5	105	9.2	--	--	210	9.5	543	9.9	88	8.4	1320	10.8	2489	10.2
n =	15	15	11	11	12	12	13	13	13	13	12	12	15	15	14	14
Mean Value	377	9.4	99	8.4	100	8.2	57	8.2	119	9	28	8	131	9	204	8
Maximum	2416	11.9	550	11.6	584	11.5	228	10.9	543	12.3	158	12.6	1320	11.9	2489	12.3
Minimum	5	6.2	<1	4.9	1	5.0	<1	5.0	<1	4.7	<1	4.9	<1	4.6	<1	5.7

TABLE1 – GROUP MONITORING RESULTS

Note: TSS is in mg/L and pH is in Standard Units (su)

Words of Wisdom: Expanding or Building a New Plant

NPCA file photo

Proper planning and intelligent equipment selection are the first and fundamental steps before construction begins.

BY MEL MARSHALL, P.ENG.

Regardless of whether you are considering entering the precast concrete industry, entering a new marketing area or expanding an existing facility, a number of factors will be a part of your decision-making process. The amount of money that you want to spend, and the amount that you can afford to spend, are not always the same.

One of your first decisions needs to be about the products that you intend to manufacture. You will want to conduct a market survey of the proposed location for your new facility to determine how many other precast concrete manufacturers, if any, are active in the market that you wish to enter. Keep in mind that even though there may be no producers in the area, that region may be serviced by precasters from remote locations. Several horror stories exist about folks who invested a great deal of money without doing a proper market survey to determine whether or not there was a need for the products they planned to produce.

Another early decision that must be made is the size and configuration of the property, as well as the size and shape of the building (if one is required). The building should be sized to provide suitable clearances around machinery and production areas to provide a safe environment and efficient operation. The location of the building on the property is important to minimize product handling, maximize yard storage, and ensure the efficient flow of trucks hauling raw materials onto the property and finished product away to the job site.

Having determined a market requirement for specific products, one of the initial points you will want to consider is how you are going to precast those products. Will you wet-cast or dry-cast? These two basic methods of manufacturing precast products involve different types of manufacturing equipment.

Wet-cast production

Wet-cast generally refers to concrete products that have a water/cement (w/c) ratio greater than 0.45, or a lower w/c ratio that uses a superplasticizer to make it flow. Because wet-cast concrete is very fluid and flows easily, one form set per piece of precast product is required to contain the concrete. After the concrete has set and sufficiently cured, the forms are stripped from the product and reused.

Although the investment in form equipment can be substantial, the cost is directly proportional to the number of pieces that you want to produce each day. Many concrete manufacturers start out with just a few forms, and then add to their form inventory as market demands increase.

One advantage of wet-casting is that it is not necessary

for the precaster to invest in a concrete batch plant. Quality ready-mix concrete is readily available from a large number of suppliers, so utilizing this concrete source can be very effective, particularly during your formative years. As sales increase and your concrete requirement increases, there may be financial justification to construct your own concrete batch plant. With regards to ready-mix concrete, you will want to consider constructing your production facility as close to a ready-mix operation as possible. In fact, some wet-cast precasters have set up their production facility on the property of the ready-mix supplier, when space is available. In these situations, the ready-mix supplier will frequently offer free rent to secure the supply of ready-mix to the precaster.

Depending on the climatic conditions, it may or may not be necessary to construct a building to house the production process. Many wet-casters pour their products outdoors, while others erect a structure with a roof but no walls to offer some protection from the elements. If you are going to produce outside, however, it is important to protect the freshly poured product from the elements such as rain, direct sunshine and wind.

Another major consideration is the method of pouring concrete into the forms, as well as handling the forms and finished product. Concrete that is poured directly from a ready-mix truck or concrete batch plant into a concrete bucket can be distributed to the forms by forklifts or an overhead crane. Larger production facilities often use flying buckets to carry the concrete from the mixer to concrete-holding hoppers located at the respective production stations.

You will want to consider how you are going to vibrate the product. Vibrators are powered with electricity, pneumatics or hydraulics, and are available in a number of different sizes and shapes. A common method of internal vibration is to utilize stick vibrators (stinger vibrators) that are inserted into the concrete between the inner and outer forms. This can be an effective method, but it requires a significant labor cost in order to achieve consolidation.

Form vibration is less labor intensive than stick vibration, but it requires the mounting of vibrators on the forms. Although there is an investment in vibrators, labor is reduced and productivity is increased. It is important to mount the vibrators on brackets welded to the form stiffeners, rather than mounting them directly onto the skin of the form. Precasters using this vibration method need to work closely with their form and vibrator suppliers to ensure that the forms are of sufficient strength, and that the vibrators are located in the right positions on the form.

Table vibration is very effective for flat products, and it is increasing in popularity for smaller products as well. This system

NPCA file photo

involves vibrators mounted below the table to impart vibratory forces to the product.

Self-consolidating concrete (SCC) has become very popular, as it has proven to be very effective for wet-cast production. This material utilizes fourth-generation superplasticizers (known as polycarboxylate admixes) and Viscosity Modifying Agents (VMAs) to produce a concrete that is almost as fluid as water but does not segregate. SCC is so fluid that it is measured by slump flow (spread) rather than slump. The spread can vary from about 20 to 32 in., depending on the product. Because SCC is self-leveling and consolidates under its own weight, it pours easily and quickly without the need for vibration. The finished product will have virtually no bug holes.

Dry-cast products

Dry-cast concrete is a zero-slump concrete with a w/c ratio below 0.4, but commonly in the range of 0.30 to 0.36. Because this concrete is very stiff, it is possible to strip it immediately from the form. Dry-cast production equipment is used to consolidate these products sufficiently so that the concrete can support its own weight when placed in the curing area.

A number of different companies manufacture dry-cast systems for the production of concrete pipe, manholes, box culverts, grade rings and a number of other products. Because it is not possible to pour dry-cast concrete from a ready-mix truck, a concrete batch plant is a necessity for this type of production. Also, a building structure is required for dry-cast production, although there are a few exceptions in warm areas.

The major advantage with dry-casting is that, although investment is required in a dry-cast machine, only one form set is required for the whole day's production of a specific product. This is, as mentioned above, because of the concrete stiffness and effective consolidation. The labor cost of dry-cast products can be significantly lower than that of comparable wet-cast production but with a higher rate of output.

Dry-cast systems are available with different degrees of labor input, varying from manual to fully automated systems. Generally, investment is made in a dry-cast facility only when there is a large demand for the items being produced.

Other equipment

Depending on the type of machinery, off-bearing and stripping of product will be handled with overhead cranes, forklifts or automated handling equipment.

If you are going to be batching your own concrete, you will need to consider the size and types of aggregates you will be using, and suitably size the aggregate bins to match the requirements of your mixer. Also think about the number of cement silos you will need to hold cement, fly ash, slag and blended cements. Be sure to size the mixer properly. The size of the mixer can be dependent upon the quantity of concrete you pour per hour, or the size of the pouring bucket (for wet-cast products) that you plan to use. The larger the pouring bucket, the more concrete you can pour at one time. For example, if you are going to pour large utility boxes, you would likely consider a larger pouring bucket than if you are going to pour concrete into smaller forms such as small meter boxes.

Curing is an important part of concrete production that is all too frequently overlooked. Keep in mind that curing (the hydration reaction between the cementitious materials and water) is essential to the formation of concrete. It is, therefore, imperative that the moisture not escape from the concrete product during the curing process so that sufficient moisture will hydrate virtually every particle of cement. If adequate curing does not occur, it will not be possible to achieve the mix design strengths. Concrete products must be protected from wind and direct sunlight during the curing process.

Although not necessary, we strongly recommend the inclusion of a QC testing facility at your new plant. It is possible to arrange for testing at independent laboratories, but this can be costly and not nearly as convenient as conducting your own tests. By doing your own testing, you will find it much easier to modify your mix designs in order to achieve the most efficient and effective mix designs that will enable you to produce the strongest, highest-quality products.

If financial resources are limited, you may want to consider purchasing used equipment. This can be a very cost-effective way to start out, but you will want to ensure that the equipment you are purchasing is in good working order. There are frequently good buys on used equipment, but there is also a lot of dysfunctional used equipment.

Conclusion

Investing in a new facility is a major undertaking, so take the time to carefully study your requirements. Always keep in mind that it is far less costly to make mistakes on paper than at the building site. Use the assistance of experienced suppliers, who are very knowledgeable in their respective fields. With proper planning and intelligent equipment selection, there is every reason to expect your new plant to be very efficient, safe and productive.

Best wishes for a successful installation. PI

Mel Marshall, P.Eng., is owner of Mel C. Marshall Industrial Consultants Inc. based in Delta, British Columbia. He has been actively involved in the design, manufacture and construction of concrete products and structures for more than 40 years. Visit precastconcretebc.com.

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CONCRETE BATCHING PLANTS

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Not always seen as a critical area for the typical precast plant, the ties that bind managers, supervisors and employees can directly impact a manufacturer's bottom line – positively or negatively.

How to Build Relationships Between Management and Production

BY BRIDGET McCREA

Creating strong ties between production personnel and managers is an ongoing challenge for most manufacturers. Traditionally, these two areas of responsibility attract two entirely different personalities, backgrounds and skill sets – yet they are expected to work in harmony for the overall good of the company. Bridging the gap between the two requires a deliberate, methodical strategy based on open lines of communication and understanding.

This is the first of a two-part human resources article that broaches a topic many manufacturers choose to avoid: establishing clear lines between the production floor and the management staff. In this segment, we'll look at how to build strong, lasting bonds between management and production. In the next issue, we'll show you how to successfully transition production workers into management positions. The goal is to help you establish strong principles around these two important human resources issues and ultimately create a stronger, more cohesive company.

The ties that bind

Armen Alajian understands the value of developing strong ties between his firm's production and management personnel. As owner of ARTO Brick in Gardena, Calif., he also knows achieving that goal isn't always easy. "It's vital to have good relationships between the production laborers and the management teams," says Alajian. "Without it, the company doesn't run properly. That's because people are assets – not tools."

With 56 employees and a strong family-owned work ethic, he says the company's leaders and managers "overtly engage those staff members who show up every day, ready to work." Communication is important, Alajian adds, as is giving praise where it is due and keeping employees apprised of the company's accomplishments, progress and challenges.

"We want our plant floor employees to know that we are all working hard," says Alajian, "and that we're showing it by giving out the highest level of respect possible combined with

monetary rewards – both of which are very important to all employees." He sees the fact that all of ARTO Brick's managers worked on the production floor before moving up the ranks as a positive for the manufacturer and its employees.

"Just the fact that they are all trained on production mechanics and processes, and that they have performed and moved up the ranks," says Alajian, "makes the communication lines that much easier to establish between management and production."

The building blocks

In many cases, a lack of communication prevents strong ties from forming between production and management personnel, and ultimately leads to lower respect and trust levels between the two groups. In most cases, that lack of trust germinates on the plant floor, where production personnel are left out of the loop on major decisions that could impact them. Such sentiments can quickly lead to gridlock in the production cycle.

Greg Chase, president of Chase Consulting in West Harwich, Mass., says having good lines of communication between workers and their supervisors and/or managers can assuage the situation and keep the production needle closer to (if not right on) the 100% level.

Chase, who teaches a class that covers communication during The Precast Show, says asking questions – and then listening to the answers – are the first steps to achieving that 100% productivity level and the associated benefits that come with a solid production-management connection. Don't expect that exercise to be easy, particularly for the managers. "The process takes time and patience," says Chase, who points to the typical manager's "Type A" personality (defined as: headstrong, assertive and in charge) as a stumbling block for precasters looking to create more harmony between departments.

"Managers have to be proactive and assertive as a part of their jobs, but in this scenario they have to take the time to develop their listening skills instead of telling others what to do," says Chase. Next, encourage managers to "walk the four corners" of the company on a daily basis, along the way interacting with employees in all departments, asking questions and listening to concerns. "The key is to make yourself visible," says Chase. "That's really important to employees, and it goes a long way in creating bonds and relationships that wouldn't otherwise exist. Plus, you learn more about people, which in turn supplies you with better input regarding their management potential."

Connecting the dots

Precasters striving to connect the dots between production and management personnel should involve their production supervisors in the process, according to Chase, who sees these individuals playing an essential role in a smooth-running plant. "Production supervisors should also maintain good housekeeping safety and quality," says Chase. Where many of them fall short, however, is in the management tactics and skills – something they didn't necessarily learn while working on the plant floor (where many supervisors get their start). "They need training on how to interact with the employees (the 'people skills') that they're overseeing and help understanding the difference between their past and current responsibilities," says Chase.

The opposite scenario can also pose challenges, according to Gustavo Gonzalez, president of Safe-T At Work LLC in Fort Lauderdale, Fla. "Some managers have never been involved in the production process and don't understand the basic fundamentals behind it," he points out. Or they limit their presence on the floor to a short walk in the morning to reassure themselves that everything is running. "Some are good at reading reports and figures, but lack the basic concept of how to mix concrete. Others rely on the plant superintendent or manager to keep them informed."

Gonzalez says bridging the gap between production and management is not an issue that is unique to precasters. It impacts every business enterprise that wants to find continuity in its operations. "If we as precasters do not produce a consistent product – with built-in quality, in an efficient manner, and delivered on time – the organization plainly ceases to exist," says Gonzalez. "Management and production are in place to complement each other in their respective functions, and this is a relationship that

5 TIPS FOR EFFECTIVE RELATIONSHIP BUILDING

Tom Armour, co-founder of Toronto-based High Return Selection, a company that helps firms implement innovative methods to improve profitability and employee engagement, offers these five tips to precasters that want to create better relationships between management and production:

1. **PRIORITIZE HIRING.** Plant employees must be hired based on their commitment to productivity and quality along with loyalty and dedication, among other things. Office workers and especially managers must be hired for their ability to be team players across the company, and managers must be able to form trust and relationships with all employees.
2. **GET THEM INVOLVED.** When you hear of issues from the floor, fix them fast. This earns respect, trust and credibility, and floor employees will become part of the solution. Celebrate success jointly.
3. **FORM A CRITICAL MASS.** Many organizations fail to understand that when you have a core group of great employees, they form a critical mass that helps management improve the plant.
4. **WALK THE FOUR CORNERS REGULARLY.** Leadership is critical. Supervisors and other required office workers need to get out and into the plant frequently and should be on a first name basis with employees. Trust is built over time and with integrity.
5. **PREVENT DEATH BY A THOUSAND CUTS.** Too many companies implement cuts or layoffs on a quarterly basis. This continual cutting of people, benefits and pay is reactive and destroys loyalty and relationships. The hidden and long-term costs of this far exceed the quarterly savings. Instead, make one comprehensive cut and then rebuild commitment.

should be based on trust and effective communication."

Karen Gureghian, a Minneapolis-based HR consultant, says the key to building these relationships is communication. For example, she's seen manufacturing companies set up television monitors in the production break area and then use the displays to disseminate regular updates on new accounts, business developments, company performance and company news.

Setting up regular employee meetings – either formal or informal – where current and relevant information can be shared between departments is another step in the right direction. "You want constant communication back and forth between employees and the management team," says Gureghian. "This really helps to bridge the gap between 'us' and 'them.'"

Overcoming the hurdles

If building relationships between management and production is on your company's "to do" list for 2013, expect the effort to be met with skepticism – at least initially. "That skepticism will be the first hurdle as management works to convince production that this isn't some new fad or experiment," says Gonzalez. As mentioned earlier, building trust should be the first step, as it will allow managers to "walk the walk" and serve as proper role models, he adds.

Next, figure out if your company actually has a problem in this area, and whether top and supervisory managers recognize the issue – or not. If they don't, getting them to cooperate and become engaged with any new initiative will be difficult at best. "If management doesn't think it has a relationship problem, then any other step or strategy will be useless," Gonzalez warns. "The first questions to ask are, 'Do I really know what is going on at my plant? Can I step into the plant and recognize if we have a problem or not?' If the answer to these questions is no, then it is time to take a Concrete Production 101 course," he adds.

When and if management recognizes that there is a relationship problem, Gonzalez says the next step is for those personnel to educate themselves in the production process and understand the issues that may or may not affect the bottom line of the business. "They need to participate, get involved, listen to the production personnel, and try to find solutions together," he advises.

Establishing two-way lines of communication will be another key step for most manufacturers, and in particular those that haven't historically cultivated such conduits. "One-way communication may be effective between kings and servants, but it has outlived its purpose," says Gonzalez. "To be most effective, management must listen to the feedback from production and react accordingly. Money is not made behind a desk in a fancy office, but it is made pouring concrete in the forms."

Reaping the rewards

Precasters who take the time to assess, cultivate and/or fix the bonds between their production and management personnel can expect big rewards in return. Not only will the workplace itself be more harmonious, but plant floor personnel will be more productive, safer and loyal. Managers will be able to allocate their time and efforts more effectively as well.

"Almost immediately you'll see higher morale among employees and a greater sense of purpose across the workforce," says Gonzalez. Other key benefits include lower absenteeism rates, more teamwork, better return on investment (in human resources) and – ultimately – higher profits and a healthier bottom line for the company as a whole.

Having worked with a number of manufacturers that have successfully improved their management-production bonds, Chase says putting the time and effort into this exercise also yields better trust and respect levels within the employee, supervisor and management ranks. "When these measures increase, you wind up with better results across the board," says Chase, who adds that housekeeping, safety, production efficiency and quality levels also benefit from these efforts.

"All four areas – safety in particular – need attention and must achieve certain levels of success in a precast concrete plant," Chase says. "So as you improve the relationships and communication between management, supervisors and employees, you can also expect improvements in these other areas as well."

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.

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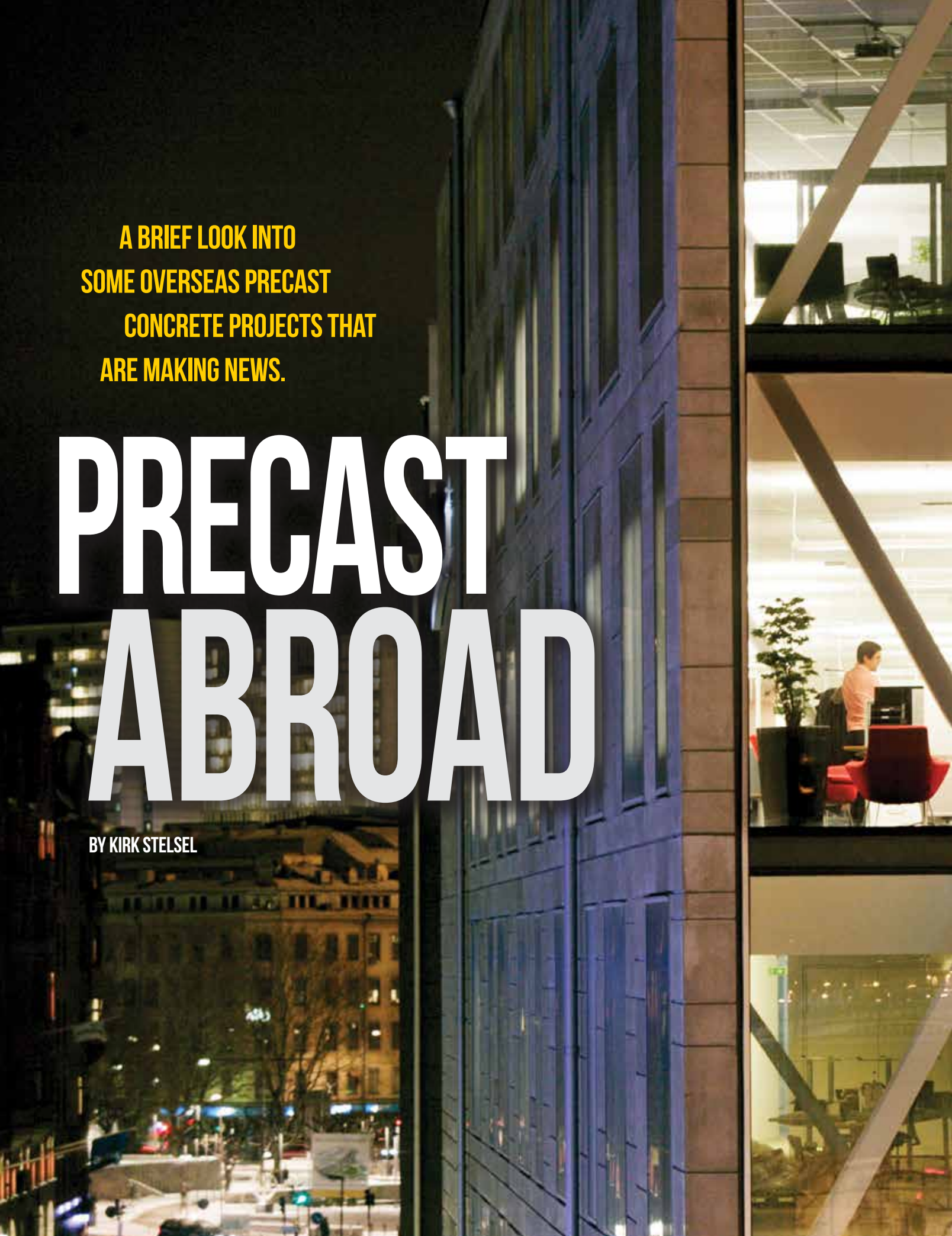

A BRIEF LOOK INTO SOME OVERSEAS PRECAST CONCRETE PROJECTS THAT ARE MAKING NEWS.

PRECAST ABROAD

BY KIRK STELSEL

Precast concretehas long been a staple building material in North America for everything from infrastructure and utility products to architectural building materials. Beyond our shores, though, a thriving and innovative global precast concrete industry can lend ideas to designers and builders here at home.

CHECK OUT THESE EXCITING PROJECTS FROM AROUND THE WORLD.

A stunning example of how precast concrete can be used to define a design, not just support it, can be found at a recent expansion to the Tel Aviv Museum of Art in Tel Aviv, Israel. The structure was designed by Preston Scott Cohen, owner of Preston Scott Cohen Inc. in Cambridge, Mass. Cohen also serves as chair of the Department of Architecture and the Gerald M. McCue Professor of Architecture at the Harvard University Graduate School of Design.

The expansion includes an exterior shell made of 460 precast concrete panels. Each panel has four sides, but no two have the same shape or size. The panels, some as large as 30 ft on one edge, were cast using flexible-edge molds that were adjusted to create the individual angles and dimensions. With so many different shapes, the need to drill holes in the casting table to bolt down the forms for pouring was eliminated by using powerful magnets to keep the sides in place.

In Stockholm, Sweden, one of the newest additions to the skyline brings to mind an iconic structure in New York City. That's because the wedge-shaped building is a sort of 21st century reboot of the famous Flat Iron Building. While the Swedish version may share a name and some design cues, that's where the similarities end.

The Swedish exterior has a distinct modern feel that stands in stark contrast to the New York version, which is punctuated by lions' heads, faces

THE FLAT IRON BUILDING IN GLASGLOW, SWEDEN, IS A MODERN REBOOT OF THE SAME-NAMED WEDGE-SHAPED BUILDING IN NEW YORK CITY. *Photo courtesy of Skanska AB*

A RECENT EXPANSION TO THE TEL AVIV MUSEUM OF ART IN TEL AVIV, ISRAEL, INCLUDES AN EXTERIOR SHELL MADE OF 460 PRECAST CONCRETE PANELS. *Photo courtesy of Preston Scott Cohen Inc.*

and terra cotta – a look that New York Magazine described as reminiscent of "an Italian Renaissance palazzo." The modern facade of the Swedish version is wrapped in precast concrete panels, which added a number of attributes to the building. In addition to the exterior panels, the contractor used hollow-core slabs and interior wall panels throughout the building.

With a short construction timeline, the use of precast allowed Skanska, the building contractor, to achieve the desired look while increasing job-site efficiency to get the building to the rental market as quickly as possible. The precast facade panels also eliminated a lot of potential construction issues due to the site being in the heart of Stockholm, bordered by a railway and a busy street with cars, pedestrians and bicycles.

The panels were delivered to the site with preinstalled windows, which eliminated the need for bulky, expensive scaffolding during construction. With the urban location, space for building material storage was also limited, making the just-in-time delivery of the precast elements an absolute necessity for the contractor. According to Skanska, the precast also provided a high range of architectural and design options and will offer reduced management and maintenance issues throughout the building's life cycle.

Designed with sustainability in mind, the building, which contains 129,167 sq ft of office space, earned a LEED Gold certification as well. The inherent thermal mass of the precast panels allows for more efficient heating and cooling of the building, contributing to the eco-friendly attributes of the building. The concrete also acts as a sound barrier between a rail depot bordering one side of the building and a residential area on the other.

At the 2014 Commonwealth Games, which will take place in Glasgow, Scotland, precast concrete will be on full display. Decomo UK Ltd. was awarded a contract to provide 32,292 sq ft of architectural precast cladding for the Emirates Arena and Sir Chris Hoy Velodrome.

The precast, which features a black exposed granite aggregate finish achieved through acid etching, creates a look that evokes the heritage of the region's coal mining past. The 398 panels

PRECAST PANELS ARE INSTALLED ON THE EMIRATES ARENA IN GLASGOW, SCOTLAND. *Photo courtesy of Decomo UK.*

PRECAST PANELS WITH WINDOWS PREINSTALLED ELIMINATED THE NEED FOR SCAFFOLDING DURING CONSTRUCTION OF THE FLAT IRON BUILDING IN STOCKHOLM, SWEDEN. *Photo courtesy of Skanska AB*

A 1,600-SPACE PARKING GARAGE AT THE COMMONWEALTH GAMES CAMPUS UTILIZED INNOVATIVE PRECAST MANUFACTURING TECHNIQUES. *Photo courtesy of SCC Ltd.*

NORTEN PH IN SPAIN HAS ENGINEERED A PRECAST CONCRETE WIND TURBINE TOWER — PRODUCED IN SEGMENTS AND ASSEMBLED ON THE JOB SITE. *Photo courtesy of Norten PH*

were used on the external facade of the two buildings and the interconnecting hub between them. Precast was specified for its durability and design flexibility, as well as inherent acoustic and thermal qualities.

Decomo was contacted by the project architect early on for general advice about the panels. Among the pieces provided by the precaster, the most unique were curved units and circular columns with a shiplap pattern. The panels were poured with a mix that included a super plasticizer additive to help reduce the water-cement ratio and enhance early strength for next-day stripping.

The panels were cast over a six-week time period after approximately four months of design work. Once on site, the precaster faced inclement weather and had to install the panels after the insulation and waterproofing had been completed, which required extra caution to not damage those materials during installing of the precast panels. The end product was well received by the client, who is working on another project with Decomo.

In addition, SCC Ltd., also located in the United Kingdom, contributed precast for a 1,600-space parking garage. The garage utilizes SCC Ltd.'s newly developed inverted frames, named IPCs (Integrate Precast Components), and its PFV (Precast Finished Voided) flooring system. Two semicircular ramps on the north end of the garage are also made of precast manufactured by SCC Ltd., and are thought to be the first of their type to be constructed in this way.

SCC Ltd. has been using the innovative system, which includes U frames consisting of floor beams and columns with infill beams between the frames, for roughly five years. Those units, along with triple-tee flooring units, make up the precast structure. The design is lighter and cost effective – 33% lighter than a typical hollowcore structure. The ramps are similar to the frames for the garage, with warped slabs and integral vehicle barriers.

All precast components were poured over a six-month period using self-compacting concrete, and the tee-shaped flooring units were poured using steel forms from AKB in conjunction with Spiroll. All other forms were wood and manufactured in-house.

Wind turbines are nothing new in the United States, but one precaster located in Bilbao, Vizcaya, Northern Spain is offering its own take on the construction of the towers. Norten PH has engineered a precast concrete tower produced in segments and assembled on the job site. The company began investigating the towers in 2002 after reading some technical magazines about precast towers for wind

turbines. Since that time, the company has designed and certified concrete towers for turbines ranging from 1.6 MW to 4.6 MW.

The towers vary in height from 361 ft to 396 ft, and incorporate anywhere from 20 to 42 post-tensioned units, depending on height and diameter. Due to the stress the wind can exert on a tower at this height, the finished product must be strong. This means a high-strength mix and plenty of reinforcement. To start, Norten PH has worked to develop a mix that achieves 8,000 to 10,000 psi at 28 days.

The mix design, a self-consolidating concrete using a superplasticizer in order to make the concrete more fluid, contains a standard aggregate, CEM I 52 R cement and no supplemental cementicious materials (SCMs). By using this mix, the company is able to achieve a high initial strength of more than 80% of final strength by the end of the first week and ensure the concrete will flow with ease over the dense cages of rebar.

Rebar weights alone range from 30 to 70 metric tons per tower, meaning a reinforcement density of 5-10 lb/ft3 and the finished units vary from 45 tons for the largest down to 15 metric tons. The walls of the units, which may include horizontal and vertical ribs, are 5 to 9 in. thick.

To date, Norten PH has installed nine towers in Spain, with the plans for 100-200 more down the road. The company feels its concrete towers are more versatile than steel towers from a diameter point of view, and in many cases the dynamic behavior is better than that of steel towers. Each tower is tailor-made as well. As the wind turbine industry trends toward larger and larger towers, steel towers also become heavy and impossible to transport in several tube segments.

The company is currently producing its precast towers in Europe, including Spain, Germany and Finland, as well as Brazil as a shareholder in Eolicabras, a company formed in order to supply towers to the Brazilian and South American market. It has also conducted a study in the United States. With an eye to the future, Norten PH is also seeking new opportunities in other markets.

LOOKING ABROAD

For companies in North America looking to diversify into emerging markets, a look overseas can often offer insights into products and practices that have yet to take shape here. Although the information can be harder to come by, the precast community is just as friendly and willing to share advice as it is here, and the international trade associations can provide a wealth of information as well. PI

Kirk Stelsel is NPCA's director of Communication.

ASTM C27 Update

BY EVAN GURLEY

ASTM C27, Technical Committee on Precast Concrete Products, meets every year in December to address new and existing specifications, test methods and definitions. The annual meeting for 2012 was held in Atlanta, resulting in the following updates:

ASTM C890, *"Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures"* – Revisions to the existing standard were proposed. Negative votes were addressed, and the document will be resubmitted for ballot.
ASTM C1227, *"Standard Specification for Precast Concrete Septic Tanks"* – Revisions to the existing standard were proposed. A negative vote was addressed and resolved, and the document will be resubmitted for ballot.
ASTM C857, *"Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures"* – Revisions to the existing standard were proposed. Changes were approved, and the new updated standard was published.
ASTM C1089, *"Standard Specification for Spun Cast Prestressed Concrete Poles"* – Revisions to the existing document were proposed. Changes were approved, and the updated standard was published.
ASTM C1746, *"Standard Test Method for Measurement of Suspended Sediment Removal Efficiency of Hydrodynamic Stormwater Separators and Underground Settling Devices"* – This new standard was developed, approved and published in ASTM.
WK828, *"New Standard Specification for Precast Concrete Burial Vaults and Graveliners"* – The initial draft document was developed, and there were negative votes to address before resubmitting for ballot for Subcommittee vote.
WK38192, *"New Specification for Wet-Cast Precast Modular Block Retaining Wall Units"* – The initial draft document was developed, and there were negative votes to address before resubmitting for ballot for Subcommittee vote.
WK36628, *"New Test Method for Measuring the Hydraulic Capacity of Filtration Products for Stormwater Treatment"* – This is currently a working draft document.
WK3022, *"Standard Specification for Methods of Measurement and Acceptable Error for Surrogate Silica Sediments Used for the Evaluation of Stormwater Treatment Devices"* – This is currently a working draft document.
WK24908, *"Standard Determination of Suspended Sediment Removal Efficiency of Hydrodynamic Separators and Underground Settling Devices"* – This is currently a working draft document.
WK39909, *"Standard Surrogate Test Solids for Measuring Performance of Stormwater Treatment Devices"* – This is currently a working draft document.
ASTM C935 (former standard) now WK40320, *"Specification for General Requirements for Prestressed Concrete Poles Statically Cast"* – The existing standard was pulled from ASTM due to inactivity. The document has now been recirculated for vote and reinstatement.

ASTM C27, formed in 1972, is a committee of ASTM International (formerly known as the American Society for Testing Materials). ASTM C27 was formed to develop test methods, specifications, definitions and recommended practices, and to promote knowledge relating to precast concrete products exclusive to concrete pipe (ASTM C13 specifically addresses precast concrete pipe). The primary areas of interest for ASTM C27 include utility structures, architectural and structural products, agricultural products, water and wastewater treatment structures, and other special products.

ASTM C27 has six technical subcommittees, which have jurisdiction over roughly 25 standards (and they are rapidly growing). Currently, ASTM C27 has 156 voting members (205 total members) consisting of producers, users, consumers and general-interest members. There are 18 producer votes available, which is a rarity in the ASTM community. For additional information, visit astm.org/MEMBERSHIP/MemTypes.htm. If you are interested in getting involved with ASTM C27, please contact Evan Gurley at egurley@precast.org or (317) 571-9500.

Evan Gurley is a technical services engineer with NPCA.

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Concrete and CO_2

BY CLAUDE GOGUEN, P.E., LEED AP

Carbon dioxide, also known by its chemical formula CO_2, is a colorless, tasteless gas that comes from many sources – including your own lungs. You will exhale 0.0043 oz (0.12 g) in the time it takes you to get to the end of this sentence (unless you just got back from jogging, in which case it may be much more.)

This carbon dioxide from our lungs and many other natural sources exists naturally in the atmosphere. Along with other gases, CO_2 helps sustain life on our planet by retaining the sun's heat. But unnatural CO_2 is also being generated by many sources, mostly from burning fossil fuels. This and other sources of CO_2 are generally attributed to trapping heat and raising temperatures, thus contributing to what's called the "greenhouse effect." Many scientists believe this greenhouse effect causes global warming that will cause a rise in sea levels and increase the intensity of extreme weather.

Regardless of where you stand in your opinion of global warming, excess CO_2 in the atmosphere is not a good thing, and it just makes sense to reduce it where we can.

The main human activity that emits unnatural CO_2 is the aforementioned combustion of fossil fuels (coal, natural gas and oil) for energy and transportation, although certain industrial processes and land-use changes also emit CO_2. The main sources of CO_2 emissions in the United States as described by the U.S. Environmental Protection Agency (EPA) are:

1. **Generation of electricity** – 40% of CO_2 emissions
2. **Transportation** – 31% of CO_2 emissions
3. **Industry** – 14% of CO_2 emissions

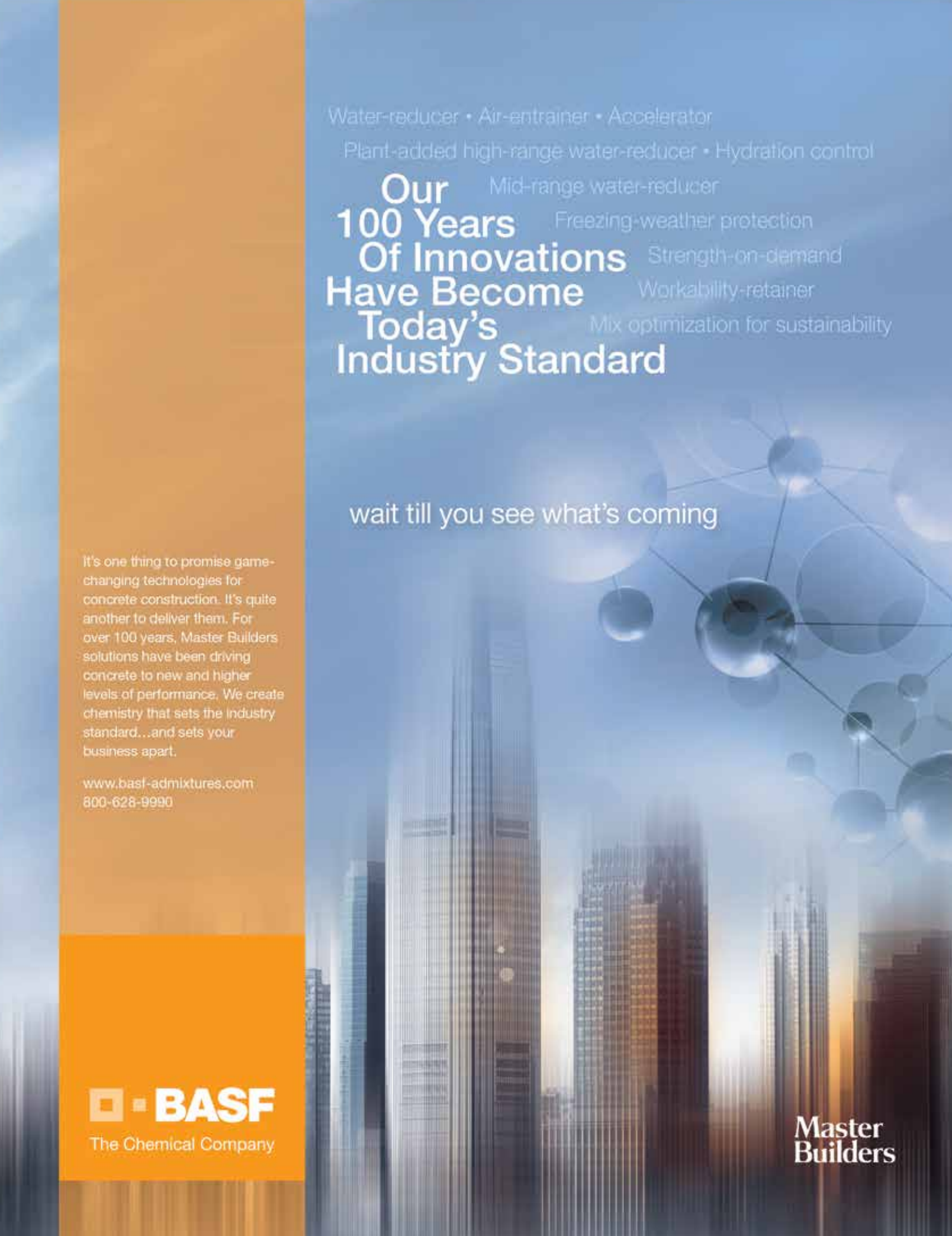
The manufacture of precast concrete structures falls in the Industry category. Although what you do at the plant every day, including manufacturing and shipping, contributes very little, it's upstream from the precast plant where we see the biggest culprit: cement.

Cement facts

Carbon dioxide emissions from a cement plant are divided into two source categories: combustion and calcination. Combustion accounts for approximately 40% and calcination 60% of the total CO_2 emissions from a cement manufacturing facility. The combustion-generated CO_2 emissions are related to fuel use. The CO_2 emissions due to calcination are formed when the raw materials (mostly limestone and clay) are heated to more than 2,500 F and CO_2 is liberated from the decomposed limestone.

In the United States, cement manufacturing accounts for a little less than 1.5% of CO_2 emissions attributable to human activities. Worldwide, cement manufacturing accounts for approximately 5% of CO_2 emissions. In the United States and elsewhere, the industry strives to further reduce that contribution.

The cement industry has made progress toward reducing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energy associated with cement manufacturing and associated emissions. Since 1972, the cement industry has improved energy efficiencies by 40%. According to the U.S. Department of Energy, U.S. cement production accounts for only 0.33% of U.S. energy consumption.

According to the World Business Council for Sustainable Development (WBCSD), throughout the 1990s, global cement production increased approximately 20% while cement industry CO_2 emissions decreased by approximately 1.5%. Emissions vary across worldwide regions from 0.73 to 0.99 lb of CO_2 per lb of cement.

What is the cement industry doing?

The high temperatures needed for cement manufacturing make it an energy-intensive process, as with the production of many building materials.

Research has led to the use of industrial byproducts in the cement manufacturing process. Pound for pound, scrap tires contain about 33% more energy than coal, and the United States generates approximately 290 millions of them each year. In 2005, about 58 million tires were consumed as fuel in cement kilns, reducing fossil fuel consumption and removing them from the waste stream.

Another recent progress involves newly introduced cement guidelines that will allow for greater use of unburned ground limestone as a component in finished cement, which will ultimately reduce calcination CO_2 by more than 2.5 million tons per year.

Today, the cement industry CO_2 accounts for less than 3% of U.S. industrial CO_2 emissions, well below other sources such as the petroleum industry (21.8%), chemical industry (22.2%), and iron and steel mills (9%).

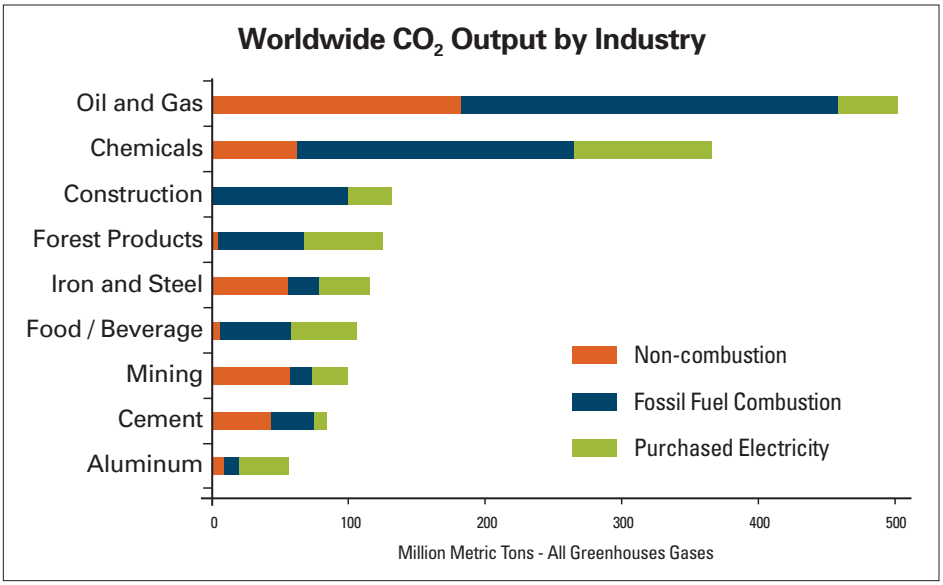
By 2020, the industry aims to reduce CO_2 emissions by 10% from the 1990 baseline levels. To achieve this goal, the cement industry has adopted a three-part strategy:

1. Improve energy efficiency by upgrading plants with state-of-the-art equipment
2. Improve product formulation to reduce manufacturing energy consumption and minimize the use of natural resources
3. Conduct research and develop new applications for cement and concrete that improve energy efficiency and durability

Putting CO_2 emissions into perspective

The manufacture of cement produces about 0.9 lbs of CO_2 for every pound of cement. Since cement is only a fraction of the constituents in concrete, manufacturing a cubic yard of concrete (about 3,900 lbs) is responsible for emitting about 400 lbs of CO_2. The release of 400 lbs of CO_2 is about equivalent to:

- The CO_2 associated with using 16 gallons of gas in a vehicle
- The CO_2 associated with using a



home computer for a year
- The CO_2 associated with using a microwave oven in a home for a year
- The CO_2 saved each year by replacing nine light bulbs in an average house with compact fluorescent light bulbs

Other sources responsible for CO_2 emissions include:
- 28,400 lbs for an average U.S. house in a year
- 26,500 lbs for two family vehicles in the United States in a year
- 880,000 lbs for a 747 passenger jet traveling from New York to London

The reason concrete is responsible for 1.5 to 2% of the U.S. CO_2 (due to humans) is the vast quantities of concrete used in the world around us. Concrete is the most widely used material on earth apart from water, with nearly 3 tons used annually for each man, woman and child.

Concrete reabsorbs CO_2

During the life of a concrete structure, concrete can reabsorb CO_2. This is done through a process known as carbonation, a chemical process where atmospheric CO_2 reacts with the Calcium Oxides (CaO) in the concrete to form calcium carbonate ($CaCO_3$). While the calcination process of cement manufacturing releases CO_2, some of it is reabsorbed during the life cycle of the concrete through carbonation.

Conclusion

Implementing a sustainable manufacturing culture at your plant should include an expectation of your upstream suppliers to do the same. The cement industry as a whole is definitely working hard to reduce emissions. Ask your cement supplier what it is doing as a company. This information will hopefully provide you with the knowledge to proudly tout the inherent sustainable attributes of your product, and the continuing progress toward decreased impacts on the environment.

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

RESOURCES

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The Internal Audit

BY PHILLIP CUTLER, P.E.

We have all heard the old sports adage: "The best defense is a good offense." Many precast concrete manufacturers today apply this adage to their businesses by performing an annual or semiannual internal audit to guard against any quality control issues. In fact, any business model today can benefit from measuring itself against its own internal policies and procedures.

For many precast plants, whether NPCA certified or not, the internal audit serves as a check to see if all things are as they should be. Some companies perform a detailed mock inspection with formal documentation, while others do a much more informal walk-through audit. If you are not performing some type of internal audit, you may be passing up internal plant improvement opportunities – or worse yet, you may be wasting valuable resources that can have a dramatic effect on your bottom line. In today's challenging market, who can afford that?

Where do I begin?

Have you heard the saying, "Eat the elephant one bite at a time"? An approach to the internal audit can be as complicated (or not) as you want to make it. Simply said, your internal audit should be geared toward the things in your facility that you believe are important and meaningful to your business.

You might choose to form small groups of plant personnel that periodically investigate key areas of your business and report their findings at your plant-wide QC meeting. These small groups would be empowered to choose when they perform their tasks but held accountable for meaningful results.

From my experience, the most effective and efficient small groups are multifaceted. In other words, they consist of plant experts from the areas of interest as well as others who don't work specifically in that area. If you plan to form a complete internal audit team, this model works well.

NPCA certified plants have a perfect opportunity and a great place to start. Each plant is required to maintain a plant-specific quality control manual that outlines all of the procedures and processes for manufacturing quality precast concrete products. The manual is required to be reviewed and updated periodically, so start with a small section or make an entire checklist and divide it among the different work groups. A great place to start is following the process of how your products are manufactured from the time the raw materials hit your yard until the pre-pour inspection is completed and documented.

What and how do I audit?

Let's use the manufacturing process just described as our example. Start by making a list (or checklist) of where the material begins in the process, then document the who, what, when, where, why and how it is processed in the plant – up to and including the point just before the concrete is deposited in the form.

Using the Certified Plant model, start with an order of reinforcing steel, for example, then a receipt of that material. What is received? Did you get a certificate? Does it include carbon equivalence data? Is the new reinforcing steel entered in your inventory software? Where is it stored and how? What happens to the identification tag? How is it picked for fabrication? Are there design and detailed fabrication documents? These and many other questions will help to complete the checklist and put the process in order so that everyone understands it.

Once the list (or checklist) is complete and the process has been defined, identify the critical elements and go to the plant floor to see that the steps are being carried out as your experts have defined. The results can be very eye-opening and create opportunities to eliminate holes in the process. Better yet, they can make improvements that save time and money for the plant. Employees get really charged up when they identify money-saving ideas or ways of improving the way a product is manufactured – especially when plant management publically acknowledges their efforts in a plant-wide Quality Control meeting.

For a sample detailed NPCA preassessment checklist, please visit precast.org/certify.

Next issue: *The contents of the semi-annual plant-wide quality meeting*

Phillip Cutler is NPCA's director of Technical Services.

HPS Earns Award for NPCA Certification Audits

The auditor for NPCA's Plant Certification program, Hanson Professional Services, has earned an Engineering Excellence Award from the Indiana chapter of the American Council of Engineering Companies. HPS was presented with a "State Finalist" award for its services in auditing NPCA's plants.

ACEC ENGINEERING EXCELLENCE AWARD

The award recognizes firms that demonstrate initiative and ingenuity in engineering. HPS and NPCA were presented with the awards at an ACEC event March 11 in Indianapolis.

Pinnacle Award Travels to Hy-Grade Precast

The NPCA Pinnacle Award, sponsored by Spillman Co., is now in its new home at Hy-Grade Precast Concrete in St. Catharine's, Ontario. Hy-Grade earned the Pinnacle title for Josh Stassen's presentation of the company's innovative Plant and Equipment Visual Maintenance Board, a simple but elegant solution for tracking the company's maintenance needs.

The award included a catered lunch by NPCA for all the employees at Hy-Grade's plant.

Hy-Grade will hold the traveling trophy until The Precast Show 2014 next February in Houston, when the next Pinnacle Award competition takes place. Visit precast.org/awards to see the presentation and learn more about the Plant and Equipment Visual Maintenance Board.

NPCA file photo

THEODORE W. COONS, PRESIDENT OF SPILLMAN CO., PRESENTED THE NPCA PINNACLE AWARD TRAVELING TROPHY TO JOSH STASSEN (CENTER) AND DOMINIC GIROTTI (RIGHT), OWNER OF HY-GRADE PRECAST CONCRETE, DURING A CATERED LUNCH FOR PLANT EMPLOYEES.

People & Products is a forum where NPCA members and nonprofit organizations can share inormation 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 NPCA. Attn: Precast Inc. magazine, 1320 City Center Drive Suite #200, Carmel, IN 46032 or email them to rhyink@precast.org.

PYTHON SAFETY INC.'S SMALL PARTS POUCH

iwi group latches on to Python Safety

iwi group LLC, a provider of services and equipment to the precast concrete industry, has announced the addition of Python Safety Inc. to its line of products. Python Safety, a leading manufacturer of products specifically designed to prevent dropped objects in the workplace, is now introducing buckets, holsters, pouches and tethers to the concrete industry.

The innovative Python Safety Small Parts Pouch accommodates many different-sized parts, and helps prevent accidental drops with a unique self-closure "trap" system engineered from high-quality neoprene. With no buttons, snaps or zippers to contend with, the Small Parts Pouch makes it nearly impossible for objects to fall out once placed in the bag, while making the retrieval of the objects easy for the craftsman. Small Parts Pouches are available in both canvas and vinyl variants.

For more information about Python Safety Inc., visit pythonsafety.com. For more information about iwi group LLC, visit iwigroup.com.

Two cousins set independent paths for family-owned companies

Weaver Precast Inc. and Weaver Masonry Inc., based in Ephrata, Pa., long managed by the same member of the founding Weaver family, will take separate business paths but remain family owned.

Gary Weaver, president of both companies since 1990, said his cousin, Nevin Weaver, has purchased a majority of the assets of Weaver Masonry and will establish a new company, NR Weaver Masonry, which will continue to focus on masonry construction. Gary will continue as president of Weaver Precast and focus exclusively on developing the precast business, both in residential and commercial markets.

"The precast business and the masonry business have developed into two distinct markets," Gary explained. "This is a strategic move that allows each business to focus more effectively on its own market. We fully expect this will facilitate growth for both businesses."

Weaver Precast manufactures and installs Superior Walls single-family, multifamily and light commercial foundation systems and serves a market area that extends from Virginia to New England.

Weaver Masonry specializes in traditional high-end block, brick and stone work on public buildings such as schools and hospitals and serves a primary market area in south central and southeastern Pennsylvania.

Currently five other members of the Weaver family work for the companies. For more information about Weaver Precast, visit weaverprecast.com. For more information about Weaver Masonry, visit weavermasonryinc.com.

Vistage Michigan names Redi-Rock marketing director to Key Executive Program

Redi-Rock International, a commercial-grade retaining wall system manufacturer based in Charlevoix, Mich., has announced that its marketing director, Jacob Manthei, was named by Vistage Michigan as the newest member to its Key Executive Program. Vistage Michigan, an affiliate chapter of the world's leading chief executive organization, provides business leaders with access to new business perspectives, innovative strategies and actionable items.

Since 2005, Manthei has worked at Redi-Rock International, which specializes in tall gravity retaining walls and critical infrastructure walls. He started with the company in an entry-level position before evolving into his current leadership role in 2008. As marketing director, he has built and managed a team responsible for national marketing, customer support, business development, systems development and management, inside and outside sales, customer relations, administration and operations.

JACOB MANTHEI

Manthei graduated summa cum laude from Arizona State University's W.P. Carey School of Business with a degree in marketing.

For more information about Vistage Michigan, visit vistagemichigam.com. For more information about Redi-Rock International, visit redi-rock.com.

SCALE-TRON'S NEW BAG DISPENSER

Scale-Tron announces new bag dispenser

Scale-Tron Inc., a manufacturer of automation, sensors and weighing systems based in St. Laurent, Quebec, has introduced an all-new bag dispenser that holds up to 30 bags. Drop one, two or more, depending on the concrete batch size. Treat your fiber like an admixture, proportioning it to the batch size.

The new dispenser can be positioned to drop bags into the scale hopper, onto the aggregate belt or directly into the concrete mixer or truck – just load the fiber bags into the dispenser at the start of operation. Bags are simply placed one at a time into the feeder buckets.

The product reliably holds and dispenses all sizes of bag up to 15-in. wide, and can also hold two smaller bags or containers of granulated additives. A one-second start pulse is required, and the rest is automatic, says the company. It can be run from the admix outputs of most batch controllers with no special software, and uses a low-power, 110-volt, single-phase motor. Standard dispensers hold 20 and 30 bags. Special models are available for other quantities and oversized bags.

For more information about Scale-Tron Inc., visit scaletron.com.

Meadow Burke launches new website with user enhancements

Meadow Burke LLC, a manufacturer of precast concrete and reinforcing products, concrete forming accessories, and road and bridge products, has launched a new and greatly enhanced company website at meadowburke.com. The website sports a clean, new design with more in-depth product information that engineers, architects and contractors will find useful. It also features an e-literature section powered by interactive viewing software that includes a full array of product manuals, brochures and technical fact sheets available for on-demand viewing.

In addition to making it easier to find local service centers and connect with the right product specialist, the website also boasts a new blog that comments on industry trends and posts educational product application and installation commentary, says the company.

Elematic Inc. to build massive plant in Iraq

The parent company of Milwaukee-based precast concrete production specialist Elematic Inc. has secured a contract with South Korea's Hanwha Engineering & Construction for a massive plant in Iraq. It calls for a precast production line with a daily component output equivalent to 80,000 sq ft of housing units. Part of South Korea's largest business conglomerate, Hanwha Engineering is under contract with the Iraqi government to lead construction of 100,000 housing units in Bismaya, a satellite city near Baghdad. The development is part of extensive reconstruction and infrastructure modernization underway in Iraq.

Precast construction was chosen for its quality, speed and cost–efficiency, say Elematic officials, adding that their plant deal is valued at more than $54 million and will net the world's largest precast concrete operation. "We have been operating in both the Middle East and Korea for a long time," says CEO Mats Jungar. "This is a very significant contract for us, and it inspires us to press on with the intensive development of our business."

Gainey's Master Precaster now operations manager

Loretta Bodi, an employee with Gainey's Concrete Products in Holden, La., was recently named the plant's new operations manager. Bodi, who was awarded Master Precaster status for her successful completion of NPCA's Master Precaster curriculum in January at The Precast Show 2013 in Indianapolis, has been working with Gainey's for eight years.

"We are all very proud of Loretta here at Gainey's," said Greg Roache, president of Gainey's Concrete Products. "She joined us fresh out of college with a master's degree in math. Hard work and dedication brought her to the top of our sales team, but her passion to learn kept her keen on understanding everything about our company and the industry we serve."

Bodi is Gainey's first employee to ever graduate from this precast program, and is also the first female to earn the Master Precaster designation. "Where else but here at Gainey's, known for our talented females with big personalities," said Roache. "We are looking forward to watching her grow in her new role. We hope her story inspires others to learn

LORETTA BODI

and grow in their companies."

For more information, email Gainey's at gcp@gaineysconcrete.com or call (225) 567-2700.

Molenaar Betonindustrie B.V. celebrates 60 years

Molenaar Betonindustrie B.V., a manufacturer of specialized concrete spacers and formwork accessories based in Goes, The Netherlands, is celebrating its 60th year. A lot has happened in the construction industry since Molenaar was founded in 1953, including vast developments in the precast sector, and the company says it is proud to have contributed to them along the way.

It all started in Dordrecht, The Netherlands, where the founder saw his opportunity and devised a creative solution for a shortage of concrete spacers. And the creativity never stopped, as improvement and innovation are at its core. The company's offerings include the MoClip, the MoNoClip for SCC, the MoSwing and the MoWip.


MOLENAAR BETONINDUSTRIE B.V.

For more information about Molenaar Betonindustrie B.V., visit molenaar-concrete.com.

BASF launches new brand for the construction industry

BASF recently started to roll out its Master Builders Solutions brand in the Asia Pacific region as part of a phased global launch process. The global brand is a sign of BASF's commitment to the construction industry and represents a wide range of construction chemical solutions previously sold under a variety of specialty brands. The remaining regions of the globe will follow with launches in the fourth quarter of 2013 and the first half of 2014.

This one global brand draws on a number of successful specialty brands such as Master Builders, Glenium and Ucrete, and is based on a more-than-century-old tradition of innovations for the construction industry. BASF builds on that legacy with expertise, commitment and a customer-centered approach, says the company. In that manner, the Master Builders Solutions launch supports BASF's strategy to intensify its focus on customer industries.

The portfolio of products and services marketed under the Master Builders Solutions brand includes concrete admixtures, cement additives, chemical solutions for mining and tunneling, waterproofing, concrete protection and repair products, grouts and high-performance flooring products.

For more information about BASF, visit basf.us.

George R. Roberts Co. receives Environmental Excellence Award

The George R. Roberts Co., a precast concrete manufacturer based in Alfred, Maine, has been recognized as part of the first state-sponsored environmental achievement awards handed out in Maine since 2005.

The Alfred-based company was honored as one of six stewards of sustainability presented with the 2012 Governor's Awards for Environmental Excellence by Gov. Paul LePage and Maine Department of Environmental Protection Commissioner Patricia Aho.

The awards, administered by the Maine DEP and scheduled in conjunction with Earth Day (April 22), recognize entities voluntarily going beyond regulatory requirements to creatively and collaboratively initiate innovation that is both environmentally and economically sustainable. George R. Roberts Co. won in the "Businesses Over 15 Employees" category.

In 2010, the precaster switched on the largest solar array in the state, which now provides 90% of electrical energy needs, producing 244,000 kw hours of electricity. The company also partnered with another Maine business to develop a home-grown bioretention unit system that treats stormwater runoff from their site.

"Environmental stewardship can and should be part of every business plan," said Tim Cook, president of George R. Roberts Co., which celebrated its 50th year in 2012. "We are doing our best to lead by example."

For more information about the Maine Department of Environmental Protection, visit maine.gov/dep. For more information about George R. Roberts Co., visit georgerobertsco.com.

(LEFT TO RIGHT) MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION COMMISSIONER PATRICIA AHO, GEORGE R. ROBERTS CO. PRESIDENT TIM COOK, GEORGE R. ROBERTS CO. VICE-PRESIDENT GREG DAVIS AND GOV. PAUL LEPAGE. *(photo courtesy of the Maine Department of Environmental Protection)*

Calendar of Events

Meeting	Location	Date
NPCA 48th Annual Convention	The Homestead – *Hot Springs, Va.*	Oct. 9-12, 2013
The Precast Show 2014	George R. Brown Convention Center – *Houston*	Feb. 13-15, 2014
The Precast Show 2015	Orange County Convention Center – *Orlando, Fla.*	March 5-7, 2015

For the most up-to-date information about NPCA events, visit **precast.org**.

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