January 2011

Concrete Conveyor

AMERICAN CONCRETE INSTITUTE
SOUTHERN CALIFORNIA CHAPTER

YOUR SOURCE FOR WHAT'S HAPPENING NOW!

MARK YOUR CALENDAR!

MARK YOUR CALENDARS!

ACI Southern California Chapter
Presents:

Annual ACI Sam Hobbs Service Award

Thursday 27 January 2011

Marriott Fullerton
2701 East Nutwood Avenue
Fullerton, California 92831

5:30 PM - 6:30 PM	**Social**
6:00 PM - 7:00 PM	**Dinner**
7:00 PM - 8:00 PM	**Awards**

Cost: $50.00 Per Person

Make your reservations now!

More Details Enclosed

American Concrete Institute Southern California Chapter
P.O. Box 712740 ~ Santee, California 92072
Phone: (877) 562-2241 ~ Fax: (619) 258-5839 ~ Email: aciscc@cox.net
Visit us on the web! www.acisocal.org

PRESIDENT'S MESSAGE

Presidents Report January 2011

The Charles Pankow awards luncheon in November was without a doubt, one of the best award presentations that we have had in a long time. Congratulations to all the winners on being a part of Southern California's most interesting Concrete projects. It was fantastic to have the chance to talk with many chapter members that I haven't seen in a while; Networking is one of the benefits of being a chapter member. John and Janeen, once again provided a fantastic event.

The National Seminar "Anchorage to Concrete" that the Southern California Chapter sponsored in November was one of the best attended national seminars that we have had the opportunity to sponsor. Jeff Ferris did such a good job in promoting the event that I heard we actually ran out of books at the door due to the number of attendees and last minute walk ins. Great job Jeff!

Please plan on joining us for our first event of 2011, in which results of the voting for new directors and officers is revealed, and the Chapters Sam Hobbs award winner for 2011 is announced and celebrated.

Over the years, I have read many presidents reports at the close of their term that say the normal things like thanks, and good bye, etc.. Well, those that know me know that I do appreciate everyone's efforts and thank you is in order, but I must keep asking for more, in terms of your participation. The work, fun, planning, etc. is not over, no we as a chapter are just bringing in some new directors with new ideas on how to remain the best chapter of ACI.

And as far as any goodbyes, no not from me, I will be active in my role as past president, and also in representing the Southern California Chapter for my new commitment as a member of the ACI National Chapter Activities Committee. This Board Committees mission is to study and develop recommendations and policies for the operation of chapters of the Institute. I look forward to this opportunity to represent the chapter in a different role, at the National level.

In closing one of the next undertakings as a chapter that we are going to need help on starting this next year is for the planning of the ACI National Convention in 2017 that we have agreed to sponsor. Now, Hosting a convention is one of the "extra special benefits" that being a member of the So Cal chapter provides, Many chapters never get the opportunity, and this will be our fifth convention hosted. Don't miss the chance to get involved with one of the many committees required to plan the convention.

As work gets busier this year, make sure to stay connected by attending meetings and participating with your peers, and remember to bring a friend with you.

Stay well, Chris

Chris Forster

ACI Southern California President 2010

What's Happening NOW!

Calender of Up-Coming Events for 2011

January 27, 2011	**Sam Hobbs Service Award** **Marriott Fullerton**
February 2, 5, 9 & 12, 2011	**Field Testing Technician Certification** **Earth Systems, Palmdale**
February 5, 2011	**Flatwork Finisher Exam** **Morley Construction, Montebello**
February 16, 19, 23 & 26, 2011	**Field Testing Technician Certification** **Chino Ready Mix, Chino**
March 17, 2011	**Aggregate Plant Tour with Joey's BBQ** **Vulcan Materials, Sun Valley**
March 2, 5, 9 & 12, 2011	**Field Testing Technician Certification** **Old Castle Precast (Utility Vault), Fontana**
March 15, 22 & 24, 2011	**Concrete Strength Testing Technician** **Metropolitan Water District, La Verne**
March 16, 19, 23 & 26, 2011	**Field Testing Technician Certification** **National Ready Mix, Duarte**
April 5, 2011	**Laboratory Technician Level II** **Metropolitan Water District, La Verne**
April 6, 8, 13 & 16, 2011	**Field Testing Technician Certification** **Southwest Inspection & Testing, La Habra**
May 4, 7, 11 & 14, 2011	**Field Testing Technician Certification** **Twining Labs, Long Beach**
June 15, 18, 22 & 25, 2011	**Field Testing Technician Certification** **Chino Ready Mix, Chino**
July 13, 16, 20 & 23, 2011	**Field Testing Technician Certification** **Hilltop Geotechnical, San Bernardino**
July 19, 26 & 28, 2011	**Concrete Strength Testing Certification** **Metropolitan Water District, La Verne**
October 4, 2011	**Laboratory Technician Level II** **Metropolitan Water District, La Verne**
November 8, 15 & 17, 2011	**Concrete Strength Testing Technician** **Metropolitan Water District, La Verne**

DON'T FORGET! ALL THIS INFORMATION & MORE IS AVAILABLE ON OUR WEBSITE!
Check out our calender at www.acisocal.org frequently for updated Industry news!

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ACI PUBLICATIONS

For more information or to order any of the following publications call 248.848.3800.

ITG-8R-10: Report on Performance-Based Requirements for Concrete
This report discusses the differences between performance and prescriptive requirements for concrete, and provides information on developing performance requirements as an alternative to the current prescriptive requirements in codes and specifications. Performance-based requirements allow the contractor and concrete producer to be more innovative in concrete applications, providing an element for sustainability of concrete construction. The essential elements of a performance-based requirement are reviewed, which include the desired performance characteristics, sampling and testing procedures to verify these characteristics, and acceptance criteria. Because acceptance criteria are crucial elements of effective performance specifications, factors to consider in developing criteria that distribute risks to the owner and members of the construction team are also discussed. Considerations for implementing performance-based requirements on a project are presented and development of performance-based requirements for durability emphasized. Alternative performance-based requirements are proposed for the prescriptive durability requirements in ACI 318. Available in hard copy or PDF format. $75.50 (ACI members $46.00); Order Code ITG810.EM.

223R-10: Guide for the Use of Shrinkage-Compensating Concrete
This guide sets forth criteria and practices to ensure the development of expansive strain in concrete. In addition to a discussion of basic principles, methods and details are given covering structural design, concrete mixture proportioning, placement, finishing, and curinge. Available in hard copy or PDF format. $50.50 (ACI members $31.00); Order Code 22310.EM.

SP-273: Further Examples for the Design of Structural Concrete with Strut-and-Tie Models
This symposium publication contains 15 papers that were presented at technical sessions sponsored by Joint ACI-ASCE Committee 445, Shear and Torsion, at the 2010 ACI Spring Convention in Chicago, IL. Topics covered in the papers include an introduction to the method, design examples, common problems experienced in real design applications, additional guidance for using the strut-and-tie model (STM), and an assessment of existing requirements.
To learn more or to order this publication, go to $94.50 (ACI members $57.00); Order Code SP273.EM.

301-10: Specifications for Structural Concrete
This document covers general construction requirements for cast-in-place structural concrete and slabs-on-ground. The first five sections cover materials and proportioning of concrete; reinforcement and prestressing steel; production, placing, finishing, and curing of concrete; formwork performance criteria and construction; treatment of joints; embedded items, repair of surface defects; and finishing of formed and unformed surfaces. Provisions governing testing, evaluation, and acceptance of concrete as well as acceptance of the structures are included. The remaining sections are devoted to architectural concrete, lightweight concrete, mass concrete, post-tensioned concrete, shrinkage-compensating concrete, industrial floor slabs, tilt-up construction, precast structural concrete, and precast architectural concrete. Available in hard copy or PDF format. $93.50 (ACI members $57.00); Order Code 30110.EM.

ACI PUBLICATIONS CONTINUED

The Concrete Intrigue

"The Concrete Intrigue" is a learning and reference book. It includes columns, as well as papers and articles written by Bernard Erlin and William Hime separately and jointly. Two additional useful tools included, are ACI's "Definitions and Terminology" and a glossary of compounds, mineral names and formulas. $75.00; Order Code: TCI.EM. ACI does not offer discounts on industry publications.

MEMBER UPDATES

ACI SOUTHERN CALIFORNIA CHAPTER
NEW & RENEWED MEMBERS FOR
November & December 2010

McMilon	Fred	Special Inspection Services
Saenz	Tim	Vulcan Materials
Caputo	Anthony	McCarthy Builders

ACI SOUTHERN CALIFORNIA CHAPTER WOULD LIKE TO THANK YOU FOR YOUR SUPPORT!

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ACI Southern California Chapter – March 17, 2011 Program

"AGGREGATE PLANT TOUR"

Hosted By:
Vulcan Materials Company

This is a great opportunity to see firsthand the complexities of an aggregate processing facility. Vulcan Materials Sun Valley plant is an award winning facility that has the capacity to process over 3 million ton of material per year. In addition to the processing plant and primary crushing plant Vulcan's Sun Valley location also utilizes a railcar unloading and material import system. This is not only a unique opportunity to tour this facility up close, but also a chance to learn about the Southern California aggregate industry from the largest aggregate supplier in the USA.

*****Vulcan is committed to safety. Our policy requires that Personal Protection Equipment (PPE) be worn during the tour. PPE includes a hard hat, safety glasses and steel toe boots (or toe guards). If you are unable to furnish your own PPE, it will be provided to you during the tour. Please indicate your level of need below:

□ I do not have my own PPE. Please provide it for me during the tour.

□ I am all set. I will bring my own hard hat, safety glasses, and steel toe boots.

*****Jeans are recommended. Please, no open toe shoes, loose jewelry, or loose clothing.

Location:	11401 W Tuxford St. Sun Valley Ca 91352.	
Cost:	**Member - $30.00**	**Non-Member - $35.00**
Time:	Plant Tour Lunch Served (Joey's BBQ)	10:30 AM – 1:00 PM 12:00 PM – 1:00 PM
Reservation:	MUST be received by **Thursday March 10, 2011** Heather at: Phone – 877.562.2241; Email – aciscc@cox.net; Fax – 619.258.5839	

***Please Note this will be a pre-registered event no walk-ins will be accepted**

PAYMENT MUST BE RECEIVED TO CONFIRM RESERVATION!!!!!!
Mail to: ACI, San Diego P.O. Box 712740 Santee, CA 92072

"AGGREGATE PLANT TOUR"– March 17, 2011

Print Name ______________________________________ Phone ____________________________

Reservation Quantity Members________Reservation Quantity Non-Members________

If Members please print all Names of Members ____

Mailing Address ____City___________________State_________Zip_________

E-mail for confirmation ____

PAYMENT: ___ Check (payable to ACI, Southern California International Chapter) **OR** ___Visa ___MasterCard ___American Express

Card # ____Security Code __________Exp Date ________________________

Billing Address of Credit Card ____City__________________State________Zip______________

Signature ____

Cancellation: Heather 877/562.2241 - Please CANCEL your reservation(s) at least 24 hours in advance if you are UNABLE to attend.

ACI Southern California Chapter – January 27, 2011

"Sam Hobbs Award"

Topic: Installation of Officers & Directors and Presentation of Sam Hobbs Award

The *Sam Hobbs Service Award* was founded in1973. The purpose of the award is to honor Sam Hobbs, the founder of the ACI chapter system and the moving force in establishing the first chapter.

The award is made annually if, in the judgment if the Awards Committee, a qualified recipient is available. Members in good standing and not currently serving as an officer or director are eligible. The award is to recognize individual service to both the chapter and the concrete industry

Location: Marriott Fullerton at Cal State University, 2701 E. Nutwood Ave., Fullerton, CA 92831

Cost: $50

Time:

Registration / Social	5:30 PM – 6:00 PM
Dinner	6:00 PM – 7:00 PM
Presentation	7:00 PM – 8:30 PM

Reservation: MUST be received by **Friday January 14, 2011**
Heather at: Phone – 877.562.2241; Email – aciscc@cox.net; Fax – 619.258.5839

PAYMENT MUST BE RECEIVED TO CONFIRM RESERVATION!!!!!!
Mail to: ACI, San Diego P.O. Box 712740 Santee, CA 92072

"Sam Hobbs Awards"– January 27, 2011

Print Name ____ Phone ______________________________

Reservation Quantity Members_________Reservation Quantity Non-Members_________

If Members please print all Names of Members ____

Mailing Address ____City____________________State__________Zip_________

E-mail for confirmation ____

PAYMENT: ___ Check (payable to ACI, Southern California International Chapter) **OR** ___Visa ___MasterCard ___American Express

Card # ____Security Code ___________Exp Date ________________________

Billing Address of Credit Card ____City___________________State________Zip______________

Signature ____

Cancellation: Heather 877/562.2241 - Please CANCEL your reservation(s) at least 24 hours in advance if you are UNABLE to attend.

Recycled Haitian concrete can be safe, strong & less expensive

Http://www.aggregateresearch.com/article.aspx?ID=21156

Jan, 05 2011

(Haiti) -- Nearly one year after a 7.0-magnitude earthquake rocked the Republic of Haiti, engineering and concrete experts at Georgia Tech report that concrete and other debris in Port-au-Prince can be safely and inexpensively recycled into strong new construction material.

In a paper published in the Bulletin of the American Ceramic Society, researchers Reginald R. DesRoches, Kimberly E. Kurtis and Joshua J. Gresham say that they have made new concrete, from recycled rubble and other indigenous raw materials using simple techniques, which meets or exceeds the minimum strength standards used in the United States.

Most of the damaged areas of Haiti are still in ruins. The trio says their work points to a successful and sustainable strategy for managing an unprecedented amount of waste, estimated to be 20 million cubic yards.

"The commodious piles of concrete rubble and construction debris form huge impediments to reconstruction and are often contaminated," says DesRoches, professor and Associated Chair of Civil and Environmental Engineering at Georgia Tech. "There are political and economic dilemmas as well, but we have found we can turn one of the dilemmas -- the rubble -- into a solution via some fairly simple methods of recycling the rubble and debris into new concrete."

DesRoches, who was born in Haiti, traveled several times in 2010 to Port-au-Prince to gather samples of typical concrete rubble and additionally collect samples of two readily available sand types used as fine aggregates in some concrete preparation.

He and Gresham also studied the methods, tools and raw materials used by local laborers to make concrete mixes. DesRoches recalls they encountered no mixing trucks. "Instead, all of the construction crews were manually batching smaller amounts of concrete. Unfortunately, they were mixing volumes of materials 'by eye,' an unreliable practice that probably caused much of the poor construction and building failure during the earthquake," he says.

Before leaving, DesRoches and Gresham manually cast an initial set of standard 3-inch by 6-inch concrete test blocks using mixes from several different construction sites.

They returned to Georgia Tech with their cast blocks, sand samples and notes, where they were joined by Kurtis, also a professor and Chair of the American Concrete Institute's Materials Science of Concrete Committee.

They quickly discovered that the concrete test samples cast in Haiti were of poor quality. "The Haitian-made concrete had an average compressive strength of 1,300 pounds per square inch," says Kurtis. "In comparison, concrete produced in the U.S. would be expected to have a minimum strength of 3,000 pounds per square inch.

They then manually crushed the samples with a hammer to provide course aggregate for a second round of tests. In this round, they made concrete samples from mixes that combined the course aggregate with one of the two types of sands they had collected. However, instead of "eye-balling" the amounts of materials, in this round of tests they carefully measured volumes using methods prescribed by the American Concrete Institute. The materials were still mixed by hand to replicate the conditions in Haiti.

Subsequent tests of samples made from each type of sand provided good news: The compressive strength of both of the types of new test blocks, still composed of Haitian materials, dramatically increased, showing an average over 3,000 pounds per square inch.

"Based upon these results, we now believe that Haitian concrete debris, even of inferior quality, can be effectively used as recycled course aggregate in new construction," says Kurtis. "It can work effectively, even if mixed by hand. The key is having a consistent mix of materials that can be easily measured. We are confident are results can be scaled up mix procedure where quantities can be measured using common, inexpensive construction equipment."

DesRoches is pleased because recycling eliminates two hurdles to reconstruction. "First, removing the remaining debris is nearly impossible because there are few, if any, safe landfill sites near Port-au-Prince, and the nation lacks the trucks and infrastructure to haul it away. It is better to use it than to move it. "Second," DesRoches says, "Finding fresh aggregate is more difficult than getting rid of the debris. It is costly to find, mine and truck in."

The trio notes recycled concrete aggregate has been used worldwide for roadbeds, drainage, etc., and that many European Union countries commonly use 20 percent recycled aggregates in structural concrete. Published research by others has also demonstrated that the use of local-sourced recycled aggregate concrete production can be more sustainable.

Because of the urgency of quick and safe reconstruction, the researchers urge that recycling the debris quickly move from proof-of-concept to large scale testing. "More work must be done to characterize the recycled materials, test additional performance parameters and gauge the safest ways to crush the rubble. Seismic behavior and building codes must be studied. But, these tests can and should be done dynamically, during reconstruction, because the benefits can be so immediate and significant," says DesRoches.

DesRoches, Kurtis and Gresham say they plan on sharing their research with Haitian government officials and nongovernmental organizations working on reconstruction projects. DesRoches is hopeful that a debris strategy and infrastructure will eventually emerge from the government once the disputed presidential elections in Haiti are resolved. "Some think that many rebuilding projects have on hold for the past few months because of distraction from the elections. The next round of elections is this month, so it soon may be possible to accelerate reconstruction."

Source: sciencedaily.com

This article is a continuation of the "What's This Report For?" series, based on a technical session sponsored by ACI Committee E702, Designing Concrete Structures. In keeping with ACI's mission to provide knowledge and information for the best use of concrete, the articles will be posted on the ACI Web site (**www.concrete.org/education/edu_online_CEU.htm**) and, along with sample reports and multiple-choice questions, be used for educational materials.

The Concrete Test Report

What the designer needs to know

BY LUKE M. SNELL

Probably the most common report in the concrete industry is the concrete test report. Typically, a report is sent when a 7-day break is completed. Later, the same report is updated and resent with the 28-day test results. On a large project, these reports will quickly accumulate. So, what information can be determined from these reports?

The concrete test report serves one basic purpose: to assure those involved with a project that the right concrete was delivered to the job site. While the format of test reports can vary from one testing laboratory to the next, each will contain the information needed to determine whether the concrete meets the job-site requirements. In the U.S., a concrete test report provides documentation that random samples of fresh concrete have been taken as required in the project specifications and ASTM C172 and that a prescribed series of tests has been conducted in accordance with ASTM C31 and C39. Some of the key things that need to be reviewed in a report include:

- Identifying data, including the job-site name and location, the name and location of the laboratory, and the identification numbers of the test specimens;
- Ambient temperature at the job site;
- Location where the concrete represented by the samples has been placed in the structure;
- Date and time of sampling, as well as the identity of the individual who took the sample;
- Test results on fresh concrete (generally slump, air content, and concrete temperature);
- Curing method for the concrete samples, as well as high and low temperatures that the concrete samples underwent while in the field;
- Compressive strength of each test specimen (reported to the nearest 10 psi [0.1 MPa]);
- Type of fracture pattern; and
- Ages of the specimens when tested.

Some test report forms include space for optional comments. Useful comments might include whether water or admixtures were added at the site. A sample should be taken only after all of the water has been added to the mixture. Technicians should always note when they observe any deviations from test standards. For example, visible defects in a test specimen or cap should be noted in the test report; however, laboratories should avoid making judgments based on incomplete data. For example, some laboratories make it a practice to indicate, based on a 7-day break, that the anticipated 28-day strength will be too low. As noted in the following discussion, such a practice may not be warranted.

INTERPRETING THE RESULTS

If you are the Engineer of Record, you'll normally receive an initial set of reports after the 7-day breaks. These can be used as an early indication of the official 28-day strength. For a typical portland cement concrete, the 7-day strength is about two-thirds to three-fourths of the 28-day strength. Be careful, though! If your concrete mixture contains fly ash, for example, the strength gain may be considerably slower than for a concrete mixture with portland cement only (Fig. 1).[1] Comparing the two may cause unnecessary distress and even panic. You'll have a much better basis for comparison if your concrete supplier has strength-gain data for the particular concrete mixture being evaluated.

Another thing to keep in mind is that an official compressive strength test in accordance with ACI 318-08, Section 5.6.2.4,[2] is the average of two 6 x 12 in. cylinders or three 4 x 8 in. cylinders, not a single cylinder break. A single, apparently low break could be significant, but it's almost impossible to know exactly what it means. If you need a reliable indication of the 7-day strength, break enough cylinders to provide an official test.

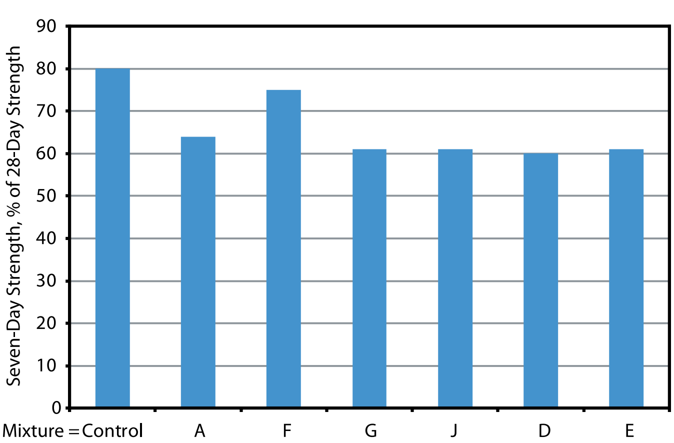


Fig. 1: The rate of strength gain is a function of the mixture proportions, so there is no single ratio that can be used for predicting the 28-day strength. In this test series, a control mixture comprising portland cement achieved about 80% of its 28-day strength in 7 days. Other mixtures with 25% fly ash replacement achieved from 60 to 75% of their 28-day strengths in 7 days (data from Reference 1)

It's helpful to track the measured strength of the concrete using a simple quality control chart of strength versus test date.[3] That way, you can see any patterns that develop. Another plot that could provide a useful indication of what should be expected for 7-day results is a chart of the ratios of the 7- and 28-day strength results.

WHAT IF A TEST RESULT ISN'T ACCEPTABLE?

ACI 318-08, Section 5.6.3.3, gives two criteria for accepting the strength of the concrete:

- The average of any three consecutive strength tests equals or exceeds f'_c; and
- No individual strength test falls below f'_c by more than 500 psi when f'_c is 5000 psi or less or by more than 10% of f'_c when f'_c is greater than 5000 psi.

If the test result fails to meet either of these criteria, you'll need to take appropriate measures for the concrete represented by the failed test(s) and for any concrete yet to be placed on the job. Details of how to apply these procedures are given in ACI's Concrete Knowledge Center.[4] But what measures are appropriate?

Checking the procedures

It's helpful to keep in mind that almost any deviations from the procedures specified by ASTM C31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field," or ASTM C39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens," will result in artificially low-strength test results. The first thing to do is to check that everything was done according to the standards. A good report will leave plenty of tracks to follow, and you should check them all, preferably with the cooperation of the testing laboratory.

Ideally, the laboratory will have done some checking before issuing the report. They may also have internal records of additional data they don't include in their written reports but that could provide additional clues. Although not all laboratories do so, it's good practice to retain all specimens that fail to meet the specified strength to aid in the investigation. Some specific items to look for include:

- Mishandling of the specimens either directly after casting or when moving them from the field to the laboratory. Gripping freshly cast specimens from the top can distort them. At 24 hours, specimens are relatively fragile and must be protected from jarring and excessive vibration;
- Curing temperature in the field. ASTM C31 requires that the temperature of field-cured cylinders be maintained between 60 and 80°F (16 and 27°C) or 68 and 78°F (20 and 26°C) for concrete with a specified strength of 6000 psi (40 MPa) or greater. If the temperatures were lower, the early-age strength

tests will tend to be low, but the later-age strength tests will recover; higher temperatures tend to have the opposite effect. Freezing the specimens at early ages can cause permanent damage;
- Excessive relief of the finished surface of the cylinder. The tolerances are slightly different depending on whether bonded or unbonded caps are used. If the relief exceeds the tolerance, the surface of the specimen needs to be cut or ground;
- Asymmetric loading of specimens (that is, specimens not properly centered in the testing machine). The test report should make a note of asymmetric failure modes; and
- If the concrete contains a significant quantity of fly ash or slag, do not expect the 7-day breaks to reach two-thirds or three-fourths of the 28-day strength values. Also, be aware that these concretes will be more sensitive to low curing temperatures.

If you find any errors in the testing procedures, make sure they're corrected and note any test results that are suspect. If you can't find errors in the testing procedures, then there is likely something wrong with the concrete itself—probably stemming from an error that will be harder to determine. Some detective measures are described in the following, but your first step is to examine the concrete delivery ticket and verify that the right concrete was sent to the site. You should also check the batch weights against the concrete submittal to make sure that there are no significant errors in batching.

Improving future test results

As previously indicated, the testing procedures themselves can be significant sources of unacceptably low strengths. The testing laboratory should go over all of the procedures point by point to make sure that they are in full compliance with the relevant standards (ASTM C31, C39, and either C617 or C1231 for bonded or unbonded caps, respectively). You can also verify that all technicians have the appropriate certifications for laboratory or field testing (from ACI or other organizations) and that the laboratory maintains certification from the Cement and Concrete Reference Laboratory or another relevant agency.

Your test reports should include the air content of the fresh concrete, and they should note any water or admixture additions made on site. It may be possible to correlate lower-strength tests (not necessarily unacceptable strength tests) with high air contents or late additions of water.

The times when the concrete was batched and sampled are noted on the batch ticket and should also be noted on the test report. Particularly in hot weather, long delivery times can adversely affect the concrete. On large jobs, your plot of strength versus test date will provide an indication that a low test result could stem from seasonal or weather-related causes. You may see lower strengths in August, for example, due to the adverse conditions imposed by hot weather.

Investigating suspect concrete in place

The question of what to do with suspect concrete is complicated. Removing concrete is costly and causes delays in the project, especially when a lot of time has passed since the concrete was placed. For starters, it's critical to locate the suspect concrete placement within the structure for a possible investigation of the concrete properties.

ACI 318-08, Section 5.6.5.2, states, "If the likelihood of low-strength concrete is confirmed and calculations indicate that load-carrying capacity is significantly reduced, tests of cores drilled from the area in question in accordance with ASTM C42 shall be permitted. In such cases, three cores shall be taken for each strength test that falls below the values given in 5.6.3.3(b)." If you are the engineer on the project, the locations of the cores should be selected in consultation with you because you need to determine which areas of the structure are critical.

It can be extremely useful to employ nondestructive testing techniques to detect areas of relatively high or low strength within the portion of the structure in question. Most specifications don't require testing for every truckload of concrete, so there could be considerable variation within the portion of the structure being investigated. A cover meter or ground-penetrating radar should be used to locate reinforcing steel and prestressing strand so it can be avoided during coring. It may be useful to take additional cores for additional strength tests or for petrographic examination to determine the cause(s) of the low strength, either to aid in improving future performance or to assign responsibility for the costs of remedying the problem. Depending on the dimensions, it may be possible to remove a portion of a core for petrographic examination and use the rest for a strength test.

ACI 318-08, Section 5.6.5.4, states, "Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is equal to at least 85% of f'_c and if no single core is less than 75% of f'_c." If the strength is determined to be unacceptably low, you (the engineer) will need to determine whether to remove and replace the deficient concrete or to take some other remedial measure. In this situation, nondestructive test methods may be helpful in determining where to take additional cores to pinpoint the locations where concrete must be removed. In the specific case where it is known or suspected that excessive quantities of fly ash or slag cement were batched, however, it may be that the strength will eventually reach satisfactory levels. In that case, it may be helpful to take extra cores to cure at elevated temperatures as an indication of the later-age strength.

References

1. Whiting, D., "Strength and Durability of Residential Concrete Containing Fly Ash," Research and Development *Bulletin* RD099, Portland Cement Association, Skokie, IL, 1989, 42 pp.

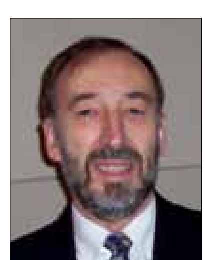
2. ACI Committee 318, "Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary," American Concrete Institute, Farmington Hills, MI, 2008, 473 pp.

3. ACI Committee 311, "ACI Manual of Concrete Inspection (SP-2(07))," American Concrete Institute, Farmington Hills, MI, 2007, pp. 16-17.

4. Snell, L.M., "Acceptance of Concrete Test Results," ACI Committee E702 Example Problems, Concrete Knowledge Center—Designing Concrete Structures, accessed at www.concrete.org/Technical/CKC/Designing_Concrete_Structures.htm, accessed Oct. 1, 2010.

Note: Additional information on the ASTM standards discussed in this article can be found at **www.astm.org**.

Selected for reader interest by the editors.



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