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Preservation of Stone Masonry Aqueducts On the Chesapeake and Ohio Canal - Part Two

By Denis J. McMullan, P.E. & Douglas E. Bond, P.E.

Structural Investigations of the Aqueducts

Mechanisms of Deterioration and Failure

The strength of the masonry arches on the canal was dependent on several factors primarily geometry, stone and mortar quality and workmanship.

The arch geometry and configuration can complicate other mechanisms due to the higher stresses caused by low rise to span ratios, thin arch barrels, and elliptical geometry. This was evidenced by the vertical sagging and the formation of hinges observed in the Catoctin Aqueduct prior to its collapse and at the center elliptical arch at the Antietam Aqueduct. Analysis of both of these elliptical arches indicates that with supports only at the springings, the line of thrust would be located outside the arch barrel stones causing the formation of hinges. However a stiff backing was provided by the mortared stone fill that is located behind the arch stones and this contributed to the resistance of horizontal arch thrusts and initially prevented the formation of hinges.

Erosion of the rock upon which the pier foundations bear, created voids under the stones. The presence of these voids at the outside face of the foundation stones was observed during underwater investigations at the Monocacy and the Catoctin Aqueducts. The formation of voids in the foundation stones



Figure 15 Hinge formations at the Catoctin Aqueduct

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Baltimore/Washington Chapter talks Vapor & Moisture Problems

On May 6, 2010 the Baltimore/Washington chapter hosted a dinner meeting for over 80 of its members at the Holiday Inn, College Park, Maryland. The topic of the meeting was moisture and vapor problems.

The B/W chapter was honored to have three past ICRI National presidents in attendance; Peter Craig, Monica Rourke and Rick Edelson.

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CHAPTER INFORMATION**3rd Quarter Membership Meeting**

FIREPROOFING OF CFRP: IS IT NECESSARY?
AND, IF SO, WHAT ARE THE RECOGNIZED APPROACHES?

September 16, 2010
Snyder's Restaurant, Linthicum, MD

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ICRI MISSION STATEMENT

The mission of the International Concrete Repair Institute is to be a leading resource for education and information to improve the quality of repair, restoration, and protection of concrete and other structures in accordance with consensus criteria.

ICRI is an organization composed of Engineers, Consultants, Contractors, Manufacturers and other Material Suppliers, Property Managers and Owners all working together for the betterment of the industry and of all involved. Providing an open forum to speak about our work, new technologies and methods, exchange ideas.

Creating and following standards to produce the best results for all involved.

PRESIDENT'S MESSAGE



As the end of August approaches, so does the end of summer. I hope that everyone had a wonderful and enjoyable summer with friends and family. Most of us will be looking forward to the cooler weather this fall after the record breaking heat we experienced in Washington D.C. and Baltimore over the past couple months.

The end of summer also brings new beginnings. New projects, a new school year, a new football season... As we begin the fall season of ICRI, I would like to focus on bringing new members to our chapter. Our local chapter members are the heart of the organization. You help make this chapter the best in the county and the board members strive to keep us at the top for many years to come. We encourage our chapter members to continue promoting the chapter and asking new members to join our outstanding organization. As you spread the word about the many benefits of ICRI, consider reaching out to your friends, co-workers, contractors, material representatives, manufacturers, engineers and building owners. Ask them to join, or at least attend a dinner meeting or outing to see what we offer as an organization. The more people with knowledge and experience in our industry, what we have in our chapter, the more we learn and grow together as an organization. Potential new members can contact Mike Prizzi, our Membership Chairman, at 410-789-7400 or mikeprizzi@metrosealant.com.

We were honored to have Peter Craig and Monica Rourke, two ICRI National Past Presidents, provide an enlightening discussion and demonstration on Correcting Moisture-Related Problems with Concrete Floors at our May dinner meeting. It was a great presentation from two people with extensive knowledge in this field.

Our September 16th dinner meeting features a panel of experts who will address the topic of "Fireproofing of CFRP; Is it Necessary and, If So, What are the Recognized Approaches?" This is a highly discussed and debated topic

in our industry. We hope to answer many of your questions on fireproofing carbon fiber reinforcing and present different perspectives from the contractor, engineer, CFRP manufacturer and CFRP fireproofing manufacturer. I hope that you will join us!

October 7th is the date of the Baltimore Washington DC Chapter Golf Outing at Glenn Dale Golf Club.

On November 4th we will have the 6th Annual Baltimore Washington DC Outstanding Repair Project Awards Program. I know that many of you have completed interesting, challenging and unique repair projects over the past year. Submit them for this year's awards program! Oscar Valenzuela can be contacted with any questions at 301-881-1441 or oscarv@skaengineers.com. Submissions are due by September 27th.

The next ICRI National Convention is being held in nearby Pittsburgh, Pennsylvania on October 20th through 22nd and will focus on "Transportation Structures". Also, ICRI's newest program, the ICRI Slab Moisture Testing Technician Certification is coming to Baltimore on October 5th and 6th. More information on this can be found at <http://icri.org/Certification/CertificationInfo.asp>

Lastly, and most importantly, elections for our chapter's 2011 officers and board members will take place in November. Neil Savitch, our 2009 Past President, is the chair of the Nominating Committee and will be taking nominations for candidates. Please contact Neil at 703-670-5300 or conspec@comcast.net if you would like your name or someone else's to be placed on the ballot. We are always looking for new members to serve on the board.

As always, chapter information, including all upcoming events, forms and chapter news can be found on our chapter website, www.icribwchapter.org. Enjoy the rest of the summer and I hope to see everyone at our September 16th dinner meeting at Snyder's Willow Grove in Baltimore.

Matt Nachman

Tadher-Cohen-Edelson Associates, Inc.

THE BALTIMORE/WASHINGTON, DC CHAPTER OF ICRI

Thursday, September 16, 2010
Snyder's Willow Grove Restaurant
841 Hammonds Ferry Road
Linthicum, MD 21090
410-789-1149
Exit 8, I-695



Advance Reservations by 09-09-10:	\$50
After 09-09-10 & Non-Members:	\$60
4:00	Board Meeting
5:30	Social Hour
6:30	Dinner & Presentation

FIREPROOFING OF CFRP:
IS IT NECESSARY?
AND, IF SO,
WHAT ARE THE RECOGNIZED
APPROACHES?

Our Moderator:

Rick Edelson, P.E. - *Principal, Tadjer Cohen Edelson*

A nationally recognized concrete restoration industry authority and a past president of both the national ICRI organization, as well as the ICRI-BW chapter. He has served as national Chair of the Technical Activities Committee for many years.

Our Panelists:

Mike O'Malley - *Principal CP&R, Restoration Contractor*

Active within local and national ICRI programs. As a contractor and engineer, Mike has provided input to the development of numerous ICRI technical guidelines, and he has an astute awareness of the benefits and limitations of the use of CFRP systems.

Dave Rodler, P.E. - *SK&A Structural Engineers, CFRP Design Engineer*

A principal of SK&A structural engineers, and manager of the firms restoration services division, Dave is active both nationally and locally in ICRI. A past national board member and past president of our local chapter, Dave currently serves as chair of the national Publications Committee as well as TAC.

Casey West - *Stanchem, the Albi Manufacturing Division, a manufacturer of Fireproofing Systems*

Founder and Chairman of StanChem, the company developed the first intumescent coatings in the U.S., and their Fireproofing division, Albi Manufacturing, has taken a lead in designing and developing fireproofing applications for CFRP.

Dave White - *Sika Corporation, CFRP Product Technical Representative*

Active in local and national ICRI committees, Dave is a past national board member and active in TAC. As a recognized national speaker and authority on the use, benefit and applications of CFRP systems, Dave is knowledgeable in the testing currently being undertaken by companies seeking to attain UL certification.

OUR FEATURED PANEL DISCUSSION:

Discussion Points

- ⇒ **Is Fireproofing of CFRP really necessary and what is gained by fireproofing?**
- ⇒ **Methods of application for fireproofing:**
 - ◆ **CFRP Sheets**
 - ◆ **Rods**
 - ◆ **Laminates**
- ⇒ **Ease and/or difficulties of fireproofing applications and installation.**
- ⇒ **QA/QC of fireproofing installations; joint responsibility of contractor/manufacturer and design engineer?**
- ⇒ **Specialized design of fireproofing protection – UL ratings and other industry standards.**
- ⇒ **What are the fireproofing manufacturer's warranties and liabilities following a fire?**
- ⇒ **Latest UL ratings and testing update.**
- ⇒ **Industry codes influencing CFRP fireproofing design.**

Audience Q&A

REGISTRATION DEADLINE IS September 9, 2010 NO-SHOWS WILL BE BILLED

Please email (pomalley@c-p-rinc.com) or print this page and fax to **Pat O'Malley**, Secretary, at 410-298-4086 no later than September 9, 2010. Checks to ICRI BWC may be turned in at the meeting or mailed with your form to:

Pat O'Malley, Secretary
ICRI BW Chapter
c/o Concrete Protection & Restoration, Inc.
6737 Dogwood Road
Baltimore, MD 21207

Name:	_____
Company:	_____
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Email:	_____
Number of Guests:	_____ Payment: <input type="checkbox"/> Enclosed <input type="checkbox"/> Online (Please include receipt)
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www.ICRIBWChapter.org

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ICRI-BWC STILL NEEDS YOUR HELP!

In January 2010, we raised \$13,550 with the help of our SPONSORS! Our thanks goes out to them!
BUT, we still have a long way to go!

We are beginning our MID-YEAR Sponsorship Drive! Our goal is to raise \$10,000 by December 2010!

HELP US REACH THIS GOAL!

The money we raise will provide increased exposure for sponsoring companies to our local and national members and, in addition, provide an additional revenue source to expand and enhance the member service program of our chapter. So, PLEASE -

BECOME A SPONSOR!

MEMBERSHIP MINUTE

BENEFITS OF MEMBERSHIP

- Industry Recognition
- Peer Networking
- Concrete Repair Bulletin and the Aggregate
- Technical Support
- Discounted Pricing for Publications

These are just some of the reasons for becoming a member of ICRI and the Baltimore/Washington, DC Chapter!

BECOME A MEMBER!

As summer and all of its good distractions comes to a close we turn our attention to the fall with a renewed energy focusing completely on business. We hope that part of your increased focus is with ICRI and your current membership status. If you have let your membership status lapse, please renew as soon as you can. If your membership status is about to expire, plan to renew before it does. ICRI National and our local chapter will be notifying you as your renewal date approaches. We look forward to seeing all of you at our September meeting in Baltimore.

Mike Prizzi

Membership Chairman

Metro Sealant & Waterproofing Supply

2010 OUTSTANDING REPAIR PROJECT AWARDS

This is a reminder to everyone that the chapter is now soliciting entries for this year's Outstanding Repair Project Awards. The project submission information is on the chapter website, http://www.icribwchapter.org/index-awards_program_orpa.htm, and entries are due by **4 p.m. on Friday, September 27, 2010.**

All entries will be judged by a panel of representatives from within our industry who are not affiliated with our chapter. Awards will be given to the Project of The Year (most points scored), and to the 2nd and 3rd Outstanding Project Awards as determined by next most points scored in descending order.

Please check the website for all submission particulars and you may also contact Oscar Valenzuela at oscarv@skaengineers.com.

VISIT OUR WEBSITE FOR MORE INFORMATION!

WWW.ICRIBWCHAPTER.ORG

Preservation

continued from page 1

themselves as seen at the Monocacy Aqueduct in Pier No. 3 and the West Pier at the Catoctin Aqueduct may be linked to the erosion of the supporting rock.

There were many forces and conditions that acted upon the aqueducts that led to their deterioration and failures. The most basic of these is the lateral pressures on the parapets and spandrel walls from water in the prism and from saturation of the fill. The impact of canal boats on the parapets also imparted lateral forces on the parapets and supporting arch barrels. The berm parapet wall at the Conococheague Aqueduct collapsed when struck by a canal boat. [7] Lateral forces on the parapets would have been resisted by friction forces between the stones in the arch barrels and mortared stone fill. Since the arch barrel stones contained compression forces in the direction of span, there would have been considerable friction forces between the stones to resist lateral forces. However, as the constant water saturation and flow into the fill gradually caused the mortar to deteriorate, the head mortar joints between the arch barrel stone would open or the stones would crack. These are believed to have developed into the long longitudinal cracks that are common among the C&O Canal Aqueducts.

Periodic flooding of the streams and creeks caused saturation of the entire structure and allowed the intrusion of flood borne silt and debris into voids in the masonry. Several inches of silt were found behind the pier face stones at the West Abutment of the Monocacy Aqueduct, at the location of a large bulge.

Also, acidity of flood waters may have caused a gradual deterioration of the mortar. At the Monocacy Aqueduct, some of the mortared stone fill was found to have a dense sand material between the stones instead of a hard mortar. Testing of the sand determined that it contained elements of deteriorated hydraulic lime mortar.

The lack of water-tightness of the aqueduct prism itself led to other problems. Once the flow of water into and through the structure occurred, a mechanism for the loss of fines in the mortar and stone fill was established. Voids were created that weakened the mortared stone masonry fill and created a path for increased water flow. Evidence of the flow of water through the structures can be seen in historic photos of the Monocacy Aqueduct.



Figure 17 Bulge at the Monocacy Aqueduct West Abutment

Freeze-thaw action of water in saturated masonry also contributed to the displacement of the stones and deterioration of the mortar between the stones. The C&O Canal aqueducts exhibit much more movement than do other arch barrel canal structures that do not carry water, such as the aqueduct at the Schoharie Creek Aqueduct on the Erie Canal that used a wooden trunk to carry water and stone arches to support the towpath.

the coping stones that cap the parapets had tilted. In all of the aqueducts, several of the spandrel wall stones had slid on the top of the arch barrel ring stones, in some cases several inches. There are many longitudinal cracks in the arch barrels and in some cases separation of the arch barrel stones by several inches. The cracks were a combination of a separation of the head joints between the arch barrel stones and cracks through the stones themselves. The cracks generally coincide with the width of the parapets and also are a greater magnitude under the berm parapets. There are also a few vertically displaced arch stones and missing arch barrel stones that may have previously dropped. In general the bed joints between the arch stones, those joints which transmit the principle arch forces in the direction of the span, were found in relatively good condition. In contrast, the head joints which are perpendicular to the bed joints were found to have missing mortar in many of the joints.

At the elliptical arches of the Catoctin and the Antietam Aqueducts, vertical deflection of the arch barrels is evident. This may have occurred immediately after removal of the centering when



Figure 16 Underwater inspection of the remains of the west pier at the Catoctin Aqueduct

Physical Indications of Structural Movements and Deterioration

Prior to the design of rehabilitation measures, a detailed inspection and assessment was made of the aqueducts. There were many indications of deterioration and displacements noted. At the Monocacy and the Antietam Aqueducts, many of



Figure 18 Water flow through the Monocacy Aqueduct



Figure 19 Longitudinal cracks in one of the Monocacy Aqueduct's arch barrels

the arch thrust caused some lateral displacement until enough passive pressure was developed in the backing fill behind the arch. The deflection also may have been caused by a loss of backing material through erosion and the creation of voids so that the horizontal thrust was no longer resisted by the backing but only by the masonry foundation at the springline. Analysis indicated that this shift or lowering of the resistance point causes tension in the arch that would allowed hinges to form and lead to the deflection of the arch.

Voids in the mortared stone fill were found at the base of test pits in the prism of the Monocacy Aqueduct, under the coping stones, and above the cracks in the arch barrels. Water testing of the voids under the coping stones indicated that the cracks and voids in the fill extended from the top of the parapets through the arch barrel. The voids were probably created by the loss of interior fill material through the large cracks in the arch barrel.

The iron railings also contributed to deterioration of the structure. The iron railing was set in holes drilled into the coping stones and about six inches from the edge of the stone, lining up with the face of the spandrel walls. The posts were placed every eight inches on center and were set in lead. Due to a combination of rust and water expansion in the hole, the coping stones often cracked along this line and the edges of the coping stones were often lost. The canal company made repairs by setting the railings back on metal straps wrapped over the parapets.

During flood events, the wrought iron railings on the towpath often caught debris which led to the coping stones being pulled off the parapet into the river below.

Analysis of Existing Conditions

A load rating of the arches for the Monocacy and the Antietam Aqueducts was performed to determine if the existing arch barrels could safely support vehicular maintenance traffic. The method used was derived from a procedure widely used in the United Kingdom (UK) for evaluating existing arch bridges in various states of disrepair. This method, initially developed by the Military Engineering Experimental Establishment (MEXE), provides for applying condition factors to the strengths of the stone and mortar used in the analysis.

To evaluate the arches, a finite element model was developed to determine the forces in the arch barrel on a per unit length basis. Loads from the fill, the parapet, and vehicles were distributed along the length of the arch and the width of the arch barrel. Stone strengths were derived from compression testing and mortar strengths assumed from published values of hydraulic cement mortars. The UK method provides for determination of the masonry strength as a function of the stone and mortar strength and sizes. Other existing conditions which affected the analysis were taken into account including the longitudinal cracks which separate the arch barrel and missing arch barrel stones. At the Monocacy Aqueduct, the arch barrels were determined to marginally support a H-15 vehicular loading, as defined by the American Association of State Highway and Transportation Officials, without strengthening. Due to the missing stones at the Antietam Aqueduct, the analysis indicated that the arch barrels need repair in order to safely support an H-15 loading.

At the Catoctin and the Antietam Aqueducts, there is an eccentricity on the pier foundations due to the unbalanced vertical and horizontal components of the smaller circular arch on one side and the larger elliptical arch on the other. The magnitude of the loads along the width of the piers varies from a maximum at the face of the spandrel walls to a minimum at the center of the prism due to the parapets which contribute more to the load than the arch and fill self weight. The weight of the water in the prism would have somewhat offset this variation in load in the pier along its length. At the Catoctin Aqueduct, a finite element analysis of the stone arches indicated that the unbalanced horizontal components produced a resultant 76 kip vertical load located outside the middle third of the base of the pier foundation due to the height of the pier. A resultant force that acts outside the middle third of a foundation creates net uplift on one edge of the foundation. Assuming that the pier stone masonry cannot resist tension, this load results in a maximum bearing stress at the base of the pier of nearly 45 ksf, a relatively high value. By reconstructing the arch barrel with a material that does not rely on arch action for stability and has a tension resisting capability, such as reinforced concrete, this bearing pressure would be reduced.

This ends Part Two. To see the rest of this article, check out our website, www.icribwchapter.org/index-aggregate.htm

INDUSTRY OUTREACH

Garrett County Habitat for Humanity



Habitat for Humanity is a nonprofit, Christian ministry that seeks to eliminate poverty and homelessness. Habitat for Humanity operates entirely on donations. This is accomplished through the efforts of volunteers, working alongside of the prospective Habitat homeowners, to build the Habitat house. In addition to volunteer labor, donations of money and materials are also accepted to help build the Habitat homes.

On Wednesday, July 21st, members of the ICRI-BW Chapter travelled to McHenry, MD to begin their volunteer work for the Industry Outreach Program. This was the second year a team of ICRI volunteers has volunteered their time to assist at the Garrett County Habitat for Humanity.

The ICRI-BW Chapter provided a total of thirteen (13) volunteers this year. Work commenced at the Garrett County Habitat for Humanity worksite on Thursday, July 22nd and was completed on Friday, July 23rd. The main focus this year was finalizing one of the home sites in preparation to turn it over to the homeowner. Work items that were completed this year included the following:

- Installed kitchen cabinets
- Installed doors and door frames
- Installed trim work
- Caulking
- Installed electrical outlets and ceiling fans.
- Installed flooring (hardwood floors and vinyl floor tile)
- Site grading
- Installed hand railing

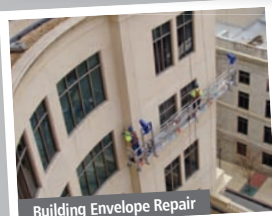
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Once again, the team of ICRI volunteers impressed the Garret County Habitat for Humanity Chapter by completing a significant amount of work in just two days. The ICRI volunteers completed in just two days, what normally takes the typical volunteers three to four weeks to complete.

This was a very worthy cause and successful effort by the group of ICRI volunteers that participated. It provided our ICRI members with an opportunity to give back our communities by helping those that are less fortunate than us.

The ICRI-BW Chapter is grateful to all of the volunteers that helped support this very rewarding project.



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Upcoming Chapter Events

Sept. 16	ICRI-BWC Membership Meeting Snyders, Baltimore, MD
Oct. 7	ICRI-BWC Annual Golf Tournament Glenn Dale Golf Club
Nov. 4	ICRI-BWC 2010 Awards Banquet Holiday Inn, College Park, MD
Dec. 2	ICRI-BWC Fall Technical Seminars CPR Warehouse Woodlawn, MD

Upcoming National Events

Oct. 5-6, 2010	ICRI Slab Moisture Testing Cert. Location: Baltimore, MD
Oct. 20-22, 2010	ICRI 2010 Fall Convention Theme: "Transportation Structures" Omni William Penn Hotel Pittsburgh, PA
Mar. 15-18, 2011	ICRI 2011 Spring Convention Expanded 3-Day Event! Theme: TBD The Westin Galleria, Houston Houston, TX

ICRI SLAB MOISTURE TESTING CERTIFICATION OVERVIEW

Are you dealing with moisture issues in concrete?

If so, the International Concrete Repair Institute (ICRI), whose mission is to be a leading resource for education and information to improve the quality of repair, restoration, and protection of concrete and other structures, has a program for you. ICRI is pleased to introduce its Slab Moisture Testing Technician Certification, Grade I program.

ICRI will be in Baltimore, MD on October 5-6, 2010! (Location TBD)

Visit www.icri.org/Certification/CertificationInfo.asp, for more information!

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LEGAL COLUMN

The False Claims Act – A Costly Trap for the Unwary

By Jennifer A. Mahar, Esquire

Searching for business opportunities in a difficult construction market, contractors and suppliers, who in the past focused primarily on the private commercial sector, are now looking to the Federal sector. If you are among those seeking to do business with the Federal Government you must realize that the rules of engagement are different from the private commercial sector due to the complex statutory and regulatory landscape. Violating just one of these Federal statutes or regulations can have serious business consequences.

Take the False Claims Act for example. The False Claims Act was enacted to protect the Federal Government and its funds from fraud. The Act prohibits, among other conduct, the knowing presentment or causing to be presented a false or fraudulent claim for payment or approval directly to the Federal Government or indirectly to the Federal Government by way of a recipient of federal funds. See 31 U.S.C. § 3729(a). If federal funds are in play on the project, either through the project owner being a Federal entity or through a Federal grant, then the False Claims Act likely applies.

The Act broadly defines "claim" as "any request or demand, whether under a contract or otherwise, for money or property . . . that is presented to an officer, employee, or agent of the United States or is made to a contractor, grantee, or other recipient, if the money or property is to be spent or used on the Government's behalf or to advance a Government program or interest" and the Government provides the funds or reimburses any portion of the requested funds. 31 U.S.C. § 3729 (b)(2). A demand for payment, such as the submission of an invoice or request for a change order, constitutes a claim under the Act.

You do not need to have a specific intent to defraud to violate the Act. The Act defines "knowing" as having actual knowledge of the information, acting in deliberate ignorance of the truth or falsity of the information, or acting in reckless disregard of the truth

or falsity of the information. See 31 U.S.C. § 3729(b) (1).

The False Claims Act applies equally to general contractors, subcontractors and suppliers. A false claim may be as basic as the submission of an invoice for payment that includes amounts for work not performed, materials not delivered, or defective work that has not been disclosed. It may also be the submission of a pass through claim from a lower-tiered contractor or supplier where the contractor incorporates a false invoice from a lower-tiered contractor or supplier into its payment application.

The consequences for violating the False Claims Act can be economically hefty. A violator is subject to a civil penalty between \$5,000 and \$10,000 for each violation plus three times the amount overstated in the false claim. See 31 U.S.C. § 3729(a). For example, if a contractor submits three false invoices which overstate the amount due by an aggregate amount of \$15,000, the contractor could face reimbursing the Federal Government \$45,000 in damages (3 x \$15,000), paying civil penalties in the range of \$15,000 to \$30,000 (3 violations at \$5,000 - \$10,000 each), and reimbursing the Federal Government its costs incurred to prosecute the false claim.

Accordingly, fundamental to succeeding in the Federal sector as a contractor or supplier are an understanding the Federal statutes and regulations which govern, such as the False Claims Act, and the implementation of appropriate processes in your business operations to make sure you comply with these requirements.

For further questions, Jennifer can be reached at jmahar@smithpachter.com or 703-847-6300.



STRENGTHENING & STABILIZATION NEWS

ACI will be presenting a 3-part program dealing with The Blast and Impact Loading Response of Concrete Structures: Experimental and Numerical Investigations session during their Fall 2010 Convention in Pittsburgh, PA on October 24th & 25th. The Program will feature presentations on the behavior of concrete structures subjected to blast and impact. This 3-part session will cover experimental investigations and numerical validation, modeling techniques and validation, and new material developments to resist extreme loadings. This program should be very informative to Engineers and other members of the industry who deal with using strengthening materials & techniques for this purpose.

REPAIR MATERIALS & METHODS NEWS

Crack Resistant Concrete Repair Technology - Concrete That Doesn't Crack?

Some major developments have occurred over the last year with the introduction of zero cracking cementitious concrete repair mortars. These new pre-bagged concrete repair materials are highly resistant to cracking and could represent a major break through in our industry. Several manufacturers are experimenting with this technology and have introduced products that are currently available to concrete repair contractors. Only time will tell...but can you imagine concrete that never cracks?

SAFETY COLUMN

Temporary Lighting

By: David Caple, COHC, CEAS

Contractors, if you use Portable Light Stands, String Lights, or Branch Circuits to complete your restoration project, listen up. You will benefit from reading about some of the common OSHA violations when using Temporary Lighting and how to apply simple solutions to avoid citations and penalties.

Construction sites have many areas requiring minimum illumination intensities ranging from 3-30 foot-candles. These requirements can be found on Table D-3 of 29 CFR 1926.56. If you type this regulation or any other regulation covered in this article into a web search you will find the specific information.

Here are a few important rules regarding the use of temporary lighting on the jobsite and ideas on how to maintain compliance. These regulations are covered under 29 CFR 1926.405(a)(2)(i) of the OSHA Standard.

- If your only source of light is temporary lighting, be sure you are not sharing the electric source with other equipment. For example, if a grinder, a hammer drill, and a portable light stand are all plugged into an outlet and the breaker trips, the employees will be in a dark and dangerous environment. Familiarize yourself with the electrical system you intend to use and if necessary provide alternate electric supplies such as a generator for your power tools.
- When using lighting in a wet or conductive location you must use 120 volt service with GFCI protection or 12 volt service. Common examples of these areas in the restoration industry include drums, tanks, vessels, tunnels, and even areas completely enclosed or partitioned with plastic, plywood, or blankets. Common operations include power-washing, and Hydro-demolition.
- Temporary lights shall not be suspended by their electric cords unless cords are designed for suspension. Newer products such as Lumapro

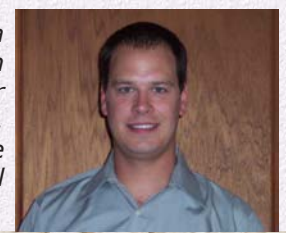
and Ericson lamps are designed for hanging by the cord although the anchor points above the lamps are preferred. When in doubt contact the manufacture of your lamps. I have done this, and in 5 minutes I had the answer I needed.

- Lamps need to be protected from contact or breakage. Operations often break bulbs or knock off the cages that protect the lamps. Instructing a competent employee to make regular checks of the lights will reduce the risk of serious injury from shock or electrocution.
- Flexible cords shall be protected from damage. Sharp corners and projections shall be avoided. Cords may pass through doorways or other pinch points if protection is provided to avoid damage. Use your imagination, the options are unlimited. For example, old hoses, carpet, blocks, etc.
- Flexible cords used with temporary and portable lights shall be designed for hard or extra hard use. The following letters will be imprinted on the exterior of the cord. (S,ST,SO,STO) or (SJ,SJO,SJT,SJTO).

Electric rules and regulations are extensive and at times confusing to people other than electricians therefore it is important to consult an electrician when in doubt. Never attempt to install or repair electrical installations unless you have been properly trained.

For more information or to recommend a topic for a future publication contact me at d.p.caple@gmail.com

David Caple, COHC, CEAS, a Construction Safety and Health Specialist, is the Principal Member of Pinnacle Safety Network, LLC. He has over 15 years experience in a combination of structural restoration and safety.



CORROSION NEWS

The corrosion resistance of new-alloyed steels has been investigated by the Virginia Transportation Research Council and many other testing and DOT Studies in heavily salted concrete blocks when compared with carbon steel bars. The investigation is intended to provide some information that would be very beneficial to the various transportation agencies on the selection of economical metallic reinforcing bars that can withstand high concentration of chloride ions in concrete bridge decks exposed to deicing chemicals.

Based on the results presented at the American Association of State Highway and Transportation Officials (AASHTO) Bridge Corrosion Committee (T-9) meeting by Dr. Gerardo G. Clemeña, the following table estimates the chloride threshold values for the microcomposite steel with 9% chromium content compared with black carbon steel and the 2101 LDX stainless steel with nominal chromium and nickel content of 21% and 1.5%, respectively.

	ASTM A615 STEEL	Stainless Steel 2101 LDX	Microcomposite Steels
Time-To-Corrosion (Macro-Cell Current)	92 Days	146 days	244 days
Chloride Threshold	460-580 ppm	2.7-3.4 times A615	4.7-5.9 times A615

The microcomposite steels have also exhibited strengths up to twice that of conventional grade 60 steel, yet maintains high levels of ductility and exhibit substantial improvement in crack, impact, and fatigue resistance over conventional reinforcing steels.

Judging from the testing and studies now underway the beginnings of this technology could be a great tool to help build & restore structures on a more sustainable basis.

Wrap-Up

continued from page 1

The presentation focused on why moisture problems occur in concrete floors and how to correct the problems. Peter Craig and Monica Rourke discussed how to test for moisture properly, moisture mitigation methods, problems due to compressed schedules and a few case studies.

In addition, information was provided on how to enroll in the new "ICRI Concrete Moisture Testing Certification" program. Visit www.icri.org/Certification/CertificationInfo.asp, for more information!

The Baltimore/Washington chapter would like to thank Monica and Peter for a very enlightening presentation. We would also like to extend a "thank you" to our Featured Meeting Sponsor Koster as well as our Platinum Plus and Platinum sponsors: Structural Preservation Systems, Kenseal, Evonik/Metro Sealants and Manganaro.



Tom Ouska presents Past President Neil Savitch with plaque for his service as 2009 Baltimore/Washington DC Chapter President.



The 50/50 winner receives his winnings!



Peter Craig explains moisture related problems with concrete floors.



Monica Rourke, the Grout Lady, explains injection with acrylates.



Monica Rourke demonstrates chemical grout.



Monica Rourke and Peter Craig honored for their presentation.

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