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MASONRY CLEANING: INTERMITTENT MIST SPRAY

by Neil Savitch, Construction Specialties Group

Conservation is generally not a dramatic process. It is frequently imperceptible and by its very nature, usually subtle. Consequently, cleaning can be one of the most satisfying processes of conservation because its results are immediately visible, and it appeals to building owners since their investment is readily seen. However, focusing on the aesthetic benefits of cleaning does risk overlooking the cause of the soiling and ignoring the history of the building. Cleaning has become one of the most controversial aspects of conservation, raising fundamental questions. Is it always necessary or even beneficial? Are we too ready to clean?



Many buildings have been damaged by cleaning in the past, and even the most appropriate cleaning techniques can be harmful. 'Cleaning' for the sake of 'cleaning' is counterproductive. More appropriately, restoring the substrate to its original patina. Removing what contaminants shouldn't be there and are not an integral part of the original substrate. Arguably, the most beneficial aspects of cleaning are to reveal the condition of the building where the dirt may have concealed cracks or structural faults and to slow down deterioration by removing damaging materials. Inappropriate cleaning methods could damage the protective shell of the structure making it more prone to deterioration and staining. It is also plausible that the soiling causes stone deterioration or decay, or reduces the permeability of the substrate; or it may simply appear as an unsightly surface discoloration.

To determine the best restoration cleaning method to use, it is first

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THE AGGREGATE INSIDE

Masonry Cleaning

A review of benefits of Intermittent Mist Spray cleaning of buildings.

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Controlling Carbon Monoxide emissions on the worksite.

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Check Out Our Upcoming Events

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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



Happy New Year ICRI BW Members! 2016 is a new year with a chance to continue the success of 2015 or start fresh with a new year. I am beginning a new initiative as president of the ICRI BW Chapter and I am excited. I must recognize and thank Brian McCabe for his great leadership and results in 2015. We added many social activities to the calendar, improved our golf tournament and increased

our monetary commitment to providing scholarships. Brian has also made a 3 year commitment to be our regional representative to ICRI National starting in 2016. Thank you for everything Brian, and we are glad to have you continuing on the board to keep the growth going.

I also must thank David Caple and Mike Prizzi for their commitments to the board. Mike held the past president position in 2015 and has fulfilled his commitment. Mike has been committed to the board and leadership of our local chapter for many years. Also, David Caple's 3 year commitment to the board of directors is complete. Thank you both for your hard work over the years and in helping to shape the association.

There are two other huge contributors to our chapter that need to be recognized for their commitment and contributions. Jay Whitton has been the Treasurer of the chapter for as long as I can remember and he is ready to start transitioning his knowledge and role to a new face. Brian Baker is going to take on this commitment for us in 2016. Jay will still be available this year as a resource.

Also, Tom Ouska has been an honorary board member for many years and is the primary reason why we are able to secure such valuable speakers and topics for our dinner meetings and technical seminar. Tom's vast network and knowledge of people in the concrete repair and waterproofing arena has been extremely valuable when we are planning our dinner meetings and technical seminar topics. He continues year after year to put in a ton of time to support the BW chapter of ICRI. It will be hard to replace him when the time comes. I would like to personally thank Jay and

Tom for their commitment to the association!

Now on to what's ahead for 2016... We have 3 new members who have been elected to the board. We have Phil Heisel from Structural, Nick Henn from ETC, and Rich Barrett from BASF. It is always great when new faces join the board and I look forward to immediate contributions from them.

As for our association goals, we will continue our drive to win chapter of the year. We are compiling the submission now in order to find out if we will win the honor in 2015. We remain the largest chapter in the country, but we have struggled to continue growing. This year we will mainly focus on attracting more people to our dinner meetings, and in growing our membership. We will continue with our scholarships, social activities, golf tournament and the technical seminar. One way to grow our membership is to talk about ICRI with people in our industry every chance you get. If you have a guest who is interested in attending, reach out to me or a board member and we may be able to get them free admission to the next dinner meeting to meet our people and see how ICRI works.

Our first opportunity for this is at our initial dinner meeting of 2016, which will be on February 11th at Maggiano's in McLean, VA. We will have Frank Morabito, of Morabito Consultants, presenting on the award winning project completed at Dolphin Towers in Sarasota, FL. I am familiar with this project after a very hospitable visit to Sarasota myself and the innovation in the design and performance of the repairs, extreme nature of the damage and effect on the unit owners along with the successful completion of the project will all make for a great presentation.

I look forward to seeing all of you at this dinner meeting, and please reach out to me at ahibshman@valcourt.net if you have any suggestions for this year or feedback for me or the board.

Sincerely,

Adam Hibshman

2016 ICRI BW Chapter President
Valcourt Exterior Building Services

MASONRY CLEANING: INTERMITTENT MIST SPRAY

Masonry continued from Page 1

important to understand the specific dirt or contaminant and its relationship with the substrate as well as the natural properties of the substrate itself. Also note that the profile of the structure and the placement in the cityscape or environment can also have an effect. Dirt or soiling may take many forms: airborne particles, gaseous pollutants and organic aerosols from industrial or vehicular emissions; biological soiling by algae, fungi, bacteria and lichen; non-biological soiling by iron staining, paint or graffiti, for example; and the list goes on. In turn, these may all be affected by water, temperature and wind, and by the effects of microclimate.

Bear in mind that a uniform surface, in general, is rarely achieved without excessive and highly damaging masonry cleaning. This is of course because so much of the cleaning is done depending on high pressure, abrasion, impact, and strength of chemicals. On many new construction projects with less fragile substrates, it may not be as big an issue. However, in the more fragile historical architectural substrates, the issue is huge. The art of cleaning, on aesthetic grounds, is to find the balance between the extremes. Often it is better to under-clean.

Of the various methods available, nebulous spray cleaning is among the gentlest. Nebulous spray, also known as intermittent mist spray, is a development of low-pressure water washing. The aim is to apply the minimum amount of water for the minimum duration to soften the dirt, thereby enabling its removal by scrubbing or other relatively gentle treatment. Ordinary low pressure water washing, by comparison, risks saturating the masonry, causing damage to the wall by mobilizing salts and causing fixings to corrode for example, as well as damaging other features fixed to the wall such as internal plasterwork, timber or decorations. It can also lead to dry rot.

The system of nebulous sprays is based on the principle of passing water through a very fine mesh or filter to create a mist that is then passed through fine nozzles. The mist spray system can be set up with nozzles at intervals along the building, concentrating on areas of greater need and reducing the level where less dirt is present. The level of water may be controlled electronically or by timers, allowing pulse or intermittent spraying, to avoid ever having water running down the face of the building. Before starting, the porosity of the stone can be assessed in order to balance the amount of water and duration required.

Nebulous spray systems can be designed to be incredibly flexible, directing the spray only where needed. Straight or flexible hoses may be employed depending on the requirements of the surface being treated and the nozzles from the hose may be grouped or spaced according to the severity of the dirt or encrustation being treated. Flat surfaces often require less water than a carved heavily soiled detail, which may require a cluster of nozzles positioned on an articulated hose to the profile of the carving.

The advantages are obvious in that being a gentler method, there is less of a chance to damage or cause deterioration of the substrates. The spray heads can be placed in a manner or configuration to put emphasis on the worst most soiled areas. The disadvantages are also obvious. The most obvious of course is the labor cost for setting up the system, maintaining, and taking it down typically in many mobilizations. Also the time in analysis of the design of the system set up, quantity and pressure of the water and making sure to avoid saturation of the substrate.

Other limitations are the limited usefulness on silacious stones (it is most effective on calcareous stones such as limestone and marble). There are also, of course, temperature and weather limitations. Also, the potential of the water bringing out efflorescence, iron staining in some substrates, further deterioration in highly deteriorated substrates thus possibly open up the possibilities to water intrusion into the building. With all this being said, in many cases, at this point, nebulous spray systems are in many cases, especially on historic structures and fragile substrates, the best possible way to restore the façade of structures rather than over-clean to the point of damaging the patina.

UPCOMING CHAPTER EVENTS

Feb 11, 2016

ICRI BWC –NCCACI Joint Meeting

Location: Maggiano's Little Italy
McLean, VA

UPCOMING NATIONAL EVENTS

Feb 1, 2016

ICRI Kick-Off Party

Location: In Conjunction with World of Concrete
Las Vegas, NV

March 16-18, 2016

ICRI 2016 SPRING CONVENTION

Location: San Juan, Puerto Rico

Nov 9-11, 2016

ICRI 2016 FALL CONVENTION

Location: The Westin Cleveland
Hotel Downtown
Cleveland, OH

2015 ICRI Fall Convention – BWC Delegate Report

by Justin Long

The 2015 Fall Convention was held in Fort Worth, Texas. This old Army outpost turned 5th largest city in Texas is still steeped in Western heritage and proved to be a superb venue to hold an ICRI convention. Being a relatively cheap flight from the Baltimore/Washington area, a number of local members were present. There wasn't a technical seminar or other event that did not have a BW ICRI member present among many others. The convention was held at the Hilton Hotel in downtown Fort Worth, which is actually the last hotel that former president John F. Kennedy stayed the night before he was assassinated. The downtown Fort Worth and surrounding area truly made you feel like you were in cowboy country. The weather during the three day convention left BW ICRI members feeling like they were on a mini-vacation as the sunny skies and high temperatures were a stark contrast from the ever dropping falls temperatures in the Baltimore/Washington area. Overall, the mood was spirited and lively as attendees navigated the numerous technical sessions, committee meetings and special events the convention has always had a reputation of producing.

First Time Attendee Reception

Prior to the kick-off of the Welcome Reception, first-time convention attendees mingled while enjoying drinks and light fare. This reception was a great opportunity for those who might be a little shy or less out going as they were able to meet and be introduced to ICRI board members and key staff and become fully submerged in the ICRI community prior to the Welcome Reception.

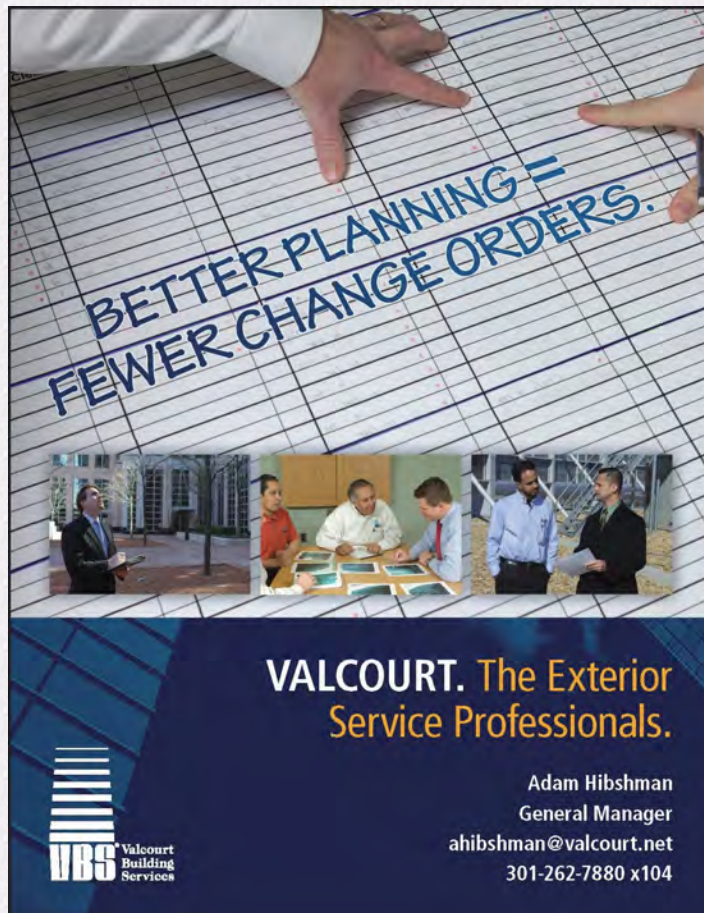
Welcome Reception

The social events began with the Welcome Reception, an ICRI Convention staple. This is the first of many opportunities throughout the convention to meet with the entire convention attendance as well as new delegates and new members. All of the exhibitors were set up and ready to educate attendees as to their specific products and services. Roaming hors d'oeuvres, small treats of finger

foods and a number of bars were part of the "lite fare" which was served and happily enjoyed by the guests. It was a nice start to a great convention. Many of the attendees went out to dinner to many of the conveniently located restaurants afterwards in large groups of old and new friends to celebrate the kick-off of another convention.

Technical Session

Choosing the technical sessions to attend on Wednesday was a simple task as the day was essentially deconflicted and allowed members to attend all sessions without conflicting committee meetings. This was not the case on Thursday and Friday, however, as committee meetings were then running congruent to the technical sessions; making it difficult to choose between two great offerings. That said, I chose the Wednesday technical sessions to attend of which I attended all five (5). The most interesting topic was presented by Michael Lee from Wiss, Janney, Elstner and Associates, Inc. who gave an interesting presentation about navigating building code requirements as they pertain to fire resistance requirements for externally repaired



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structural elements. Discussions and examples ran the gamut from traditional externally installed steel elements to FRP applications. Michael gave great insight as to how he has navigated both existing and current building code requirements to satisfy the ever evolving expectations of local building code officials and inspectors. The biggest take away for me during this session was that fire-rated assemblies and ratings should be further examined and considered in addition to all other code requirements. As always, more information regarding this technical session and all other technical sessions can be found on ICRI.org when they are posted.

AT&T Stadium Tour

The Fort Worth convention offered a unique opportunity for ICRI members (even if you were Steelers or other fans) to tour the home of the Dallas Cowboys, AT&T Stadium in Arlington, TX. The tour began as attendees gathered in the hotel lobby to be transported by bus to the stadium. Prior to the tour, guests enjoyed a wonderful lunch at Babe's Chicken Dinner, which in the center of the family style dining room, you can't miss the neon café sign featuring a cowboy on a horse twirling a lariat above his head. The water tower you walk under when entering the dining room is actually supported by legs made from the lighting towers which stood at the old Texas Stadium. Between the Southern hospitality, delicious comfort food (fried chicken and biscuits were amazing) and line dancing servers, this dinner was a true treat to kick-off an amazing stadium tour. The stadium provided us their most knowledgeable and experienced tour guides to lead us on a VIP Guided Tour. Beginning at the Main Club, the tour included a tour of Jerry Jones' private suite, the print media press box, the world's largest TV and the Cotton Bowl office vestibule. After touring these areas, our guide took members down to the event level where we saw all of the stops including the field, the Miller Lite Club, the post-game interview room and both the Cowboys' locker room and the Cheerleaders' locker room. Designed by HKS, Inc. architects, the estimate to build the stadium was \$650 million. The stadium's final construction cost was \$1.15 billion, making it one of the most expensive sports venues ever built. The most impressive part of the tour was the descriptions of the stadium structure itself with a pair of nearly 300 foot tall arches which span the length of the stadium dome, anchored to the ground at each end. This stadium tour was a true treat for those who attended.

Committee Meeting

On Thursday, I attended ICRI Technical Committee 310 Surface Preparation. This committee is chaired by Mr. Andrew Fulkerson of MAPEI. The meeting was fairly long (although this was my first committee meeting) but appeared to be most productive to those involved I am sure. Work in the committee centered around development of a small "Task Group" relating to "how and where to use" appropriate methods and equipment for surface preparation. Drafts for the document were reviewed and discussed by the committee members and subsequent reviews will take place during the Spring 2016 Convention as elements of the document are further developed.

Inter-Chapter Luncheon

The theme of the Inter-Chapter Luncheon was "Best Practices for Hired Chapter Administration". Dale Regnier and the National ICRI members compiled a list of what other

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chapters deemed successful and not-so successful with utilizing hired chapter administration at their local level. A number of the best practices were echoes of what we do here at the local level as well as our sentiments.

Chapters Committee Meeting

The Chapters Committee Meeting was the final bit of business in which a general convention attendee and designated delegate can participate. It also seemed to be very well attended by comparison to any other committee meeting I've attended. I would suspect that this perception can be directly attributed to the requirement that delegates attend this committee. The first major topic of discussion, as was during the Spring 2015 convention, was increasing attendance at Chapter Round Table Discussions. Other interesting topics for discussion were the exciting possibility of adding an ICRI local chapter in Dubai, discussions about the National Award for Chapter Innovation, a recap of the Inter-Chapter Luncheon and, of course, discussions about the Spring 2016 Convention, which is to be held in Puerto Rico! My biggest take away from the meeting in terms of impact at the local level was the indication that the industry appears to be experiencing a "grass roots" growth. Chapters have been encouraged to reach out to vo-tech schools, junior colleges and other organizations as a way to promote ICRI growth nationwide. The "Strategic Plan" was a topic introduced and will be a topic of discussion during the next Inter-Chapter Luncheon.

Overall, the convention was well planned, organized and executed. The Chapter Delegate experience was a positive one I would recommend any ICRI member to experience at least once. I'm looking forward to the Puerto Rico convention in April of 2016.

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2015 GOLF TOURNAMENT

ICRI Baltimore Washington Chapter 2015 Annual Golf Tournament



On Friday, October 30, 2015, the International Concrete Repair Institute Baltimore Washington Chapter held its Annual Golf Tournament at Little Bennett Golf Course in Clarksburg, MD, to benefit the Chapter Scholarship Fund. The tournament was held about a month later than usual due to a weather event in early October which forced the golf course to close for safety reasons. Prior to the postponement on October 2nd, 109 golfers had registered to play which would have qualified the tournament as one of the most attended in Chapter history. After the postponement, 20 additional golfers (5 foursomes) registered as well as a couple more sponsors to make the tournament the most registered without a doubt!

The day of the tournament brought cold, blustery conditions. At 8:45am, the shotgun start time, temperatures were below 40 degrees with wind blowing 15 mph out of the north. That deterred a few participants from playing but not many. The golfer count at T-time was 116. A successful number by any calculation but exceptional given the conditions!

The course was in excellent condition. The most wayward of T-balls (and there were a few of those) couldn't find hardpan. The fairways were lush and the greens true as any greens you could putt on. On all par threes, a prize was offered to anyone that hit a hole in one; sponsored by PPSI. On the sixth hole, however, the top prize was \$10,000 to any competitor that hit a hole in one. The downhill 172 yard par three posed a formidable foe. The winner of the closest to the pin contest on that hole (Sean McGinty) landed one 5'7" from the pin. A far cry from a hole-in-one but a great golf shot none the less. At the turn, competitors were treated to a putting contest for a chance to win \$5,000; sponsored by CSG Consulting Engineers. Everyone had a chance to qualify to become a semi-finalist by making a squirrely 20-foot downhill left to right breaker that if you hit it anywhere past the pin it would roll off the green. It was a difficult putt to say the least. Of the 116 entrants, only 8 qualified for the semi-finals. Of the 8 semi-finalists, Kevin Kline qualified for the chance to win \$5,000 by making a 50-foot putt on the #18 green. The putt was downhill the whole way, but Kevin managed to leave it about 4 feet short. Not a bad putt but not enough to win \$5,000. He did win a family four pack of Bowie Baysox tickets for his efforts!



The tournament concluded with the first foursome coming in at 2:21pm (a 5:26 round). Participants were treated to lunch, catered by CarterQue. Lunch was baked ziti, chili, and grilled chicken with sides. After lunch, winners were awarded (see below) their prizes, a 50/50 drawing was held (winner received \$280), and door prizes were given away; courtesy of Dewalt/Tools and Accessories and ICRI.

2015 GOLF TOURNAMENT

The tournament, which was not without challenges presented by Mother Nature, was a success yet again raising over \$6,000 to benefit the ICRI BW Chapter Scholarship Fund. Even though the tournament was well attended, the real benefit to the organization is through its sponsors. A special thanks to the sponsors is in order! They are:

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Vector Corrosion – Men's Long Drive Sponsor

Hole Sponsors (Companies listed more than once sponsored more than once):

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Choice Restoration Services, Inc	Kenseal
Commercial Waterproofing	Manganaro
CONPROCO	Metro Sealants/Evonik
Contracting Specialists	Morabito Consultants
Contracting Specialists Inc	Neogard
Cortec Corporation	Olson Engineering
Concrete Protection and Restoration	Prepcon
Concrete Protection and Restoration	SIKA
Eastern Industrial Scaffold	SKA
Engineering & Technical Consultants	SKA
Euclid	Struc'tur'al
Freyssinet	Valcourt

Competition Winners:

1st Place Team: Aaron Strong, Nick Henson, Zack Stern, Ross Reade
2nd Place Team: John Mimm, Dennis Patrick, Steve Williams, Doug West
3rd Place Team: Alan Rutherford, Ken Kostova, Bryan Monahan, Kelsey Sheridan

Closest to the Pin:

#3: Lou Bell
#6 Sean McGinty
#15 Unknown
#17 Bob Plummer

Long Drive:

Men's: Ron Gartrell
Women's: Sande Eastwood

Straightest Drive: Todd Holter



2015 GOLF TOURNAMENT



2015 GOLF TOURNAMENT



HABITAT FOR HUMANITY

ICRI BW Chapter Annual Community Outreach Habitat for Humanity

Members of the ICRI Baltimore Washington Chapter participated in the annual community outreach event with Habitat for Humanity – Metro Maryland on Saturday, November 14. In addition to a financial donation, the ICRI chapter provided volunteers to repair a single family house in Hyattsville, Maryland.

Habitat for Humanity is a non-profit organization that seeks to eliminate poverty and homelessness by building simple, decent, energy efficient, and affordable housing for those living in substandard conditions in our community. Habitat for Humanity teams with volunteers in the community to help build and renovate homes for families. In addition, the homeownership model provides an opportunity for low-income families to purchase the home and contribute to the construction with “sweat equity”.



Patrick Allen getting started with ceiling repairs.

measured and cut lumber to furr-out the exterior walls to increase insulation thickness. Vince Olds (Creative ConKrete Repair & Coatings) and Andrew Carr (Construction Insight) nailed the new lumber to the existing studs. Meanwhile, Patrick Allen (Structural Rehabilitation Group) used his height advantage to start preparing the ceiling for insulation.

Habitat provided the crew with lunch where we had the opportunity to ask questions and swap stories. During lunch, the Habitat crew explained their excellent record of getting families into homes, keeping people in their homes long term, and building communities. The Habitat crew also talked about the ReStore which sells new and gently used furniture and building materials to the public with all proceeds used for the housing projects.

The event was successful thanks to the group of volunteers that participated. It was a fun day working alongside fellow ICRI members helping those that are less fortunate achieve the dream of a stable home and community. The Industry Outreach Committee of the ICRI-BW Chapter is extremely thankful to all of the volunteers that have donated their time and skills to the Habitat for Humanity organization.

Great Work!

HABITAT FOR HUMANITY

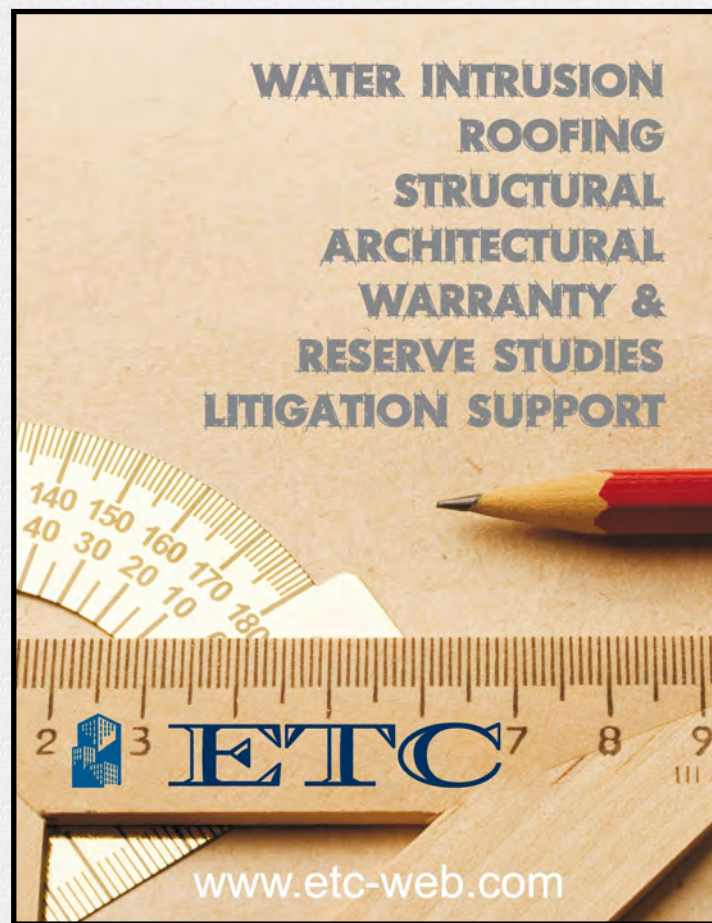


Mariam Halata saw-cutting lumber.

Vince Olds nailing the new lumber to the existing studs.



Left to right: Andrew Carr, Vince Olds, Mariam Halata, and Patrick Allen.



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NOVEMBER MEETING WRITE-UP

ICRI-Baltimore Washington Chapter Members Celebrate the 2015 Outstanding Project Award Winners



On November 5, 2015, the ICRI Baltimore Washington Chapter held its 2015 Awards Dinner Meeting at yet another new location. A special thanks to Kevin Kline (Facilities Committee Chair) who made the arrangements for the chapter's prestigious awards dinner. The Marriot Washingtonian Center in Gaithersburg, MD, was an elegant and great location for the meeting and awards dinner and will hopefully host future ICRI events.

Justin Long (Awards Committee Chair) and the rest of the Baltimore Washington chapter board members received a total of five submissions for consideration for the 2015 Baltimore Washington Outstanding Project of the Year Awards. Five judges, nationally active in ICRI, from across the country judged this year's awards on the basis of overall presentation, innovative approaches, difficulty of working conditions, use of ICRI practices and overall project success.

Ed Kluckowski with Freyssinet presented the 3rd Place Award Winning project for the NASA 1(3) Wallops Flight Facility repairs which involved extensive FRP repairs to the existing bridge spans.

Pat O'Malley with CP&R presented the 2nd Place Award Winning project for the 1000 Vermont Avenue Façade Repairs which involved intricate and detailed replacement and repairs to precast parapet wall panels.

Last, but certainly not least, Robert Radcliff with ETC presented the 1st Place Award Winning project for the Greens at Leisure World Building 2 Roof Replacement.

Each project had its own level of complexity and other technical challenges and each presenter did an outstanding job detailing how they met those challenges head on. Thanks to all of those who submitted their projects this year and to our winners for presenting their projects to share their outstanding projects and unique repair experiences!

The social hour prior to the awards dinner and presentations was a huge hit as always. With a larger attendance, the Awards Dinner social hour provided a great opportunity to catch up with old friends, network with new contacts and chat about the upcoming awards presentations.

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NOVEMBER MEETING WRITE-UP



**1st Place—Greens at Leisure World
Building 2 Roof Replacement**



**2nd Place—1000 Vermont
Avenue Façade**



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NOVEMBER MEETING WRITE-UP



**3rd Place—NASA 1(3)
Wallops Flight Facility**



**Student Applications—
Molly Berger**



**Continuing Education—
Jason Haislip**



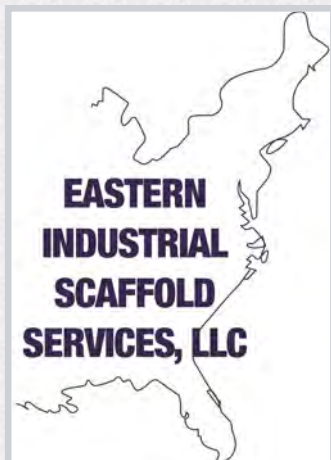
**Continuing Education—
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SAFETY COLUMN

Carbon Monoxide

by Charles J Brienza, CHST, Safety Director, Concrete Protection and Restoration, Inc.

Carbon Monoxide is arguably one of the more pervasive hazards in construction. It's nearly impossible to imagine a jobsite without a heater, generator, truck, or other piece of equipment utilizing an Internal Combustion Engine. Equally important as the worksite, when working in occupied structures pedestrians can also be affected by Carbon Monoxide. Beyond the worksite, our homes may contain a number of sources of the deadly gas that kills hundreds and injures thousands every year. If we apply some very simple "best practices" to our jobsites and our homes, you should see that Carbon Monoxide is a very controllable hazard.

Carbon Monoxide (CO) is a tasteless, odorless and colorless gas which is created in any combustion reaction that introduces Carbon (C) to Oxygen (O). On the modern concrete restoration and repair project, CO originates from two primary sources: engines and heaters. Any Internal Combustion Engine (ICE) creates or has the potential to create CO. Gasoline engines produce the greatest exhaust concentration of CO compared to Propane or Diesel (the three most commonly used fuels for construction equipment). A common misconception is that diesel or propane engines do not produce CO. That couldn't be further from the truth. Although considerably less than gasoline, diesel and propane combustion reactions create CO. Furthermore, the exhaust concentration of CO can vary depending on how well a piece of equipment is maintained. Something as simple as a clogged air filter will alter the exhaust concentration of CO. Additionally, a temporary heater caked with soot (carbon build up) in the combustion chamber will create more CO than the same heater when new.

Ideally, a contractor should evaluate means and methods to eliminate the emission of CO into the work area. This may be accomplished by switching to tools and equipment that are powered by electricity. This is easily accomplished with smaller tools such as power saws, light duty pressure washers, low volume paint sprayers or small concrete mixers. However, it is inevitable that an engine will at some point be utilized. After all, a contractor is often required to use a generator to supply electricity. Furthermore, concrete buggies, water blasters, motor vehicles as well as a number of other engine power units are very common on repair projects. When this is the case, a contractor must initiate a CO control program.

The first step in controlling CO emissions is knowing what the concentration of CO is in the work area and what the acceptable level of CO to which an employee may be exposed. For the purpose of simplicity, this article will focus on OSHA's Permissible Exposure Limit (PEL) to CO which is 50ppm (parts per million). Know that there are a number of different organizations that regulate employee exposure to CO (see figure 1); the acceptable level of exposure will vary based on location or regulation. OSHA's CO PEL of 50ppm is an 8-hour Time Weighted Average (TWA) exposure limit. Meaning over the course of an 8-hour shift, an employee may be exposed to certain peaks and valleys in their exposure as long as the overall average exposure equates to a constant 50ppm. For example, if an employee is exposed to a constant level of CO of 100ppm for one hour and no other exposure for the remainder of their 8-hour shift, the exposure would be equal to $12 \frac{1}{2}$ ppm ($100\text{ppm} \div 8 \text{ hours} = 12.5\text{ppm TWA}$); which is under OSHA's PEL and thus, allowable. However, an employer must keep in mind that the National Institute of Occupational Safety and Health (NIOSH) has set an employee exposure ceiling of 200ppm. This is a maximum level to which an employee can be exposed regardless of the length of time. A 201ppm exposure for one second would be in violation of this regulation.

Determining the level of exposure is simple. A number of gas meters are available to measure the level of CO (Fig 2). Some are diffusion models which require the device to be exposed to the atmosphere. Some have pumps that allow a user to lower a tube into a confined space to sample the atmosphere remotely. They range in size from a small cell phone all the way up to cinder block sized devices. They can be purchased as a single gas meter or a multi gas meter that can sample a number of gases/contaminants. Higher end models will log data which can be uploaded to a computer for analysis and in some cases, do so wirelessly via infrared or Bluetooth technology. The simplest way to choose a CO gas meter is to speak with a vendor of such devices. Explain to them what you are trying to accomplish and they should be able to supply you with a device that suits your needs. A single gas diffusion model is the easiest to use. A multi-gas data logger with Bluetooth communication would be the most complicated. Under no circumstances should a contractor use a CO detector designed for household use. Household CO detectors calculate the exposure as a percentage of carboxyhemoglobin (COHb) saturation in blood, not real time PPM.

Once an employer recognizes the exposure, understands the limits and acquires a CO gas meter, it is time to sample. While in fresh air, turn the gas meter on. Most models self-calibrate but only do so in fresh air. When the meter is finished calibrating you may introduce it into the environment that may contain a CO. It is important to test inside *and* outside the work area. CO that seeps into an occupied area is not only dangerous to the occupants, but it could also trigger a response by the fire department if building CO detectors are triggered. On top of that, there could be associated fines and penalties not to mention bad publicity. Most meters will have a screen which displays the actual level of CO. Most meters will begin to sound alarms of varying intensity as the exposure climbs. Usually the first level at which an alarm sounds is 25ppm (NIOSH) or 35ppm (ACGIH). A more intense alarm will sound at 50ppm (OSHA). The most intense alarm will sound when levels are above 100ppm the Short Term Exposure Limit (STEL). Again, these alarm levels can vary from device to device and many of the devices on the market can be programed to specific criteria.

Once an atmospheric sample confirms the presence of CO in the work area, the employer must initiate application of the Hierarchy of Hazard Control. In the Hierarchy of Hazard Control, the first acceptable step in controlling or eliminating the exposure is through Engineering Controls. As previously stated, the best Engineering Control available is to remove the process that creates CO. This isn't always possible. If removal of the CO source is not possible, a contractor could isolate and ventilate the source. This is accomplished by erecting a box of sorts in which a generator or pressure washer can be placed, and running a manifold from the exhaust to a safe location outside of the work area or directly into the building ventilation system. The next best possible engineering control is general ventilation of the work area to displace or dilute the CO. It is often asked; "how much ventilation is required?". Unfortunately, there is no simple answer to that question. It is based on the amount of CO generated vs. the volume of the work area. A single floor fan is almost never enough in an enclosed space. To be safe, the Contractor needs to monitor the work area with CO meters to determine how much ventilation is necessary. The vapor density of CO is 0.97, which is slightly lighter than air. Pockets of CO will not dissipate quickly without force acting upon them. They must be moved by airflow. Remember, for every fan you have pushing air into the work area, you need at least one fan pulling air out of the work area. Without the positive *and* negative pressure, air and CO will be exhausted from the work area. Once again, building occupants must be considered when general ventilation is utilized. The CO must be exhausted to a safe location.

After Engineering Controls have been exhausted, Administrative Controls are implemented. A simple Administrative Controls is relocation of CO generating equipment. Does the pressure washer or generator *need* to be in the work area? Can you place the equipment outside of the work area? When working in enclosed areas, is there a ventilation system that the building owner turns off at night when nobody is parking in the garage? Can that system be left on during the construction shift? While waiting to dump a load of concrete from a concrete buggy, the engine can be idled down to drastically reduce the amount of CO created. By limiting the number of buggies (or any type of equipment) that is running in the work area at any given time, an employer will find that the CO exposure is greatly reduced. When experimenting with Engineering and Administrative Controls, the possibilities are endless; be creative. The bottom line solution is to limit the introduction of CO into the work area and get it out as soon as possible when it does.

The final step in the Hierarchy of Hazard Control applied to CO exposure is Personal Protective Equipment (PPE). Typically, respiratory protection from CO exposure is infeasible. It's not impossible. It requires the use of a supplied air respirator as a negative pressure filtering face piece such as a dust mask or half mask respirator cannot be effectively utilized. A supplied air respirator can cost upwards of \$2,000 per worker if not more. Multiply that by the number of workers. Then factor in maintenance and training not to mention the affect having multiple workers tethered to airlines all trying to work in a small area. You can see how it *is* possible but perhaps not feasible.

As with all safety practices, employees must be trained how to protect themselves from a hazard; in this case CO. Training should instruct an employee how to apply the Hierarchy of Hazard Control, how to use and understand the readings of a CO meter, health affects of CO poisoning (see figure 3), and emergency procedures to follow should an employee be overexposed to CO. Of course, training should be documented and retained for *at least* the duration of that employee's tenure.

The Differing Site Conditions Clause

by Kenneth K. Sorteberg, Esquire

One of the greatest risks in a fixed-price construction contract is encountering unforeseen subsurface conditions during performance. To protect from such potential risk, a prudent contractor would normally include a contingency in its bid. If the risk never materializes, the owner would incur an unnecessary expense by paying more than actually necessary, while the contractor would receive a windfall.

To avoid these problems, a risk-shifting clause, known as the Differing Site Conditions clause, is often included in construction contracts. This clause usually addresses two types of differing site conditions. The first type is a subsurface or latent physical condition at the site differing materially from what is indicated on the contract documents. The second type is a subsurface or latent physical condition at the site of an unusual nature differing materially from those ordinarily encountered.

Such a clause minimizes the contractor's risk and relieves the contractor from unexpected and unfavorable conditions that could not be ascertained by a reasonable site investigation. This clause promises the contractor an equitable adjustment in contract price if a differing site condition is encountered. The clause also benefits the Owner if no differing site conditions are encountered.

The policy supporting this clause was described by the Court of Claims in a landmark decision, *Foster Constr. C.A. v. U.S.*, 435 F.2d 873, 887 (Ct. Cl. 1970):

The purpose of the changed conditions clause is thus to take at least some of the gamble on subsurface conditions out of bidding. Bidders ... need not consider how large a contingency should be added to the bid to cover the risk. They will have no windfalls and no disasters. The [Owner] benefits from more accurate bidding, without inflation for risks which may not eventuate.

Please feel free to contact Ken Sorteberg at sorteberg@constructionlaw.com with any questions or suggestions for future Legal Columns. Mr. Sorteberg is a civil engineer and an attorney (licensed in MD and DC) who focuses his practice on construction law.

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