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**ASCE Illinois Section**

# News

Vol. 53, No. 1  
January 2012

## Carving of the World's Largest Rock Monument: Where Art Meets Rock Mechanics

By C. H. Dowding

### Largest Rock Monument in the World

Crazy Horse will be the largest rock monument in the world when completed. It is already taller than the Statue of Liberty, and as shown in Figure 1, when completed it will be taller and larger than the Pyramid of Gizeh.

Unlike other rock monuments like Mt Rushmore (18 miles to the north east) and Stone Mountain, it is being carved fully in the round. Crazy Horse's three dimensional, 44 ft diameter arm and hand point to the south east, while he laments "My lands are where my dead lie

*(continued on page 3)*

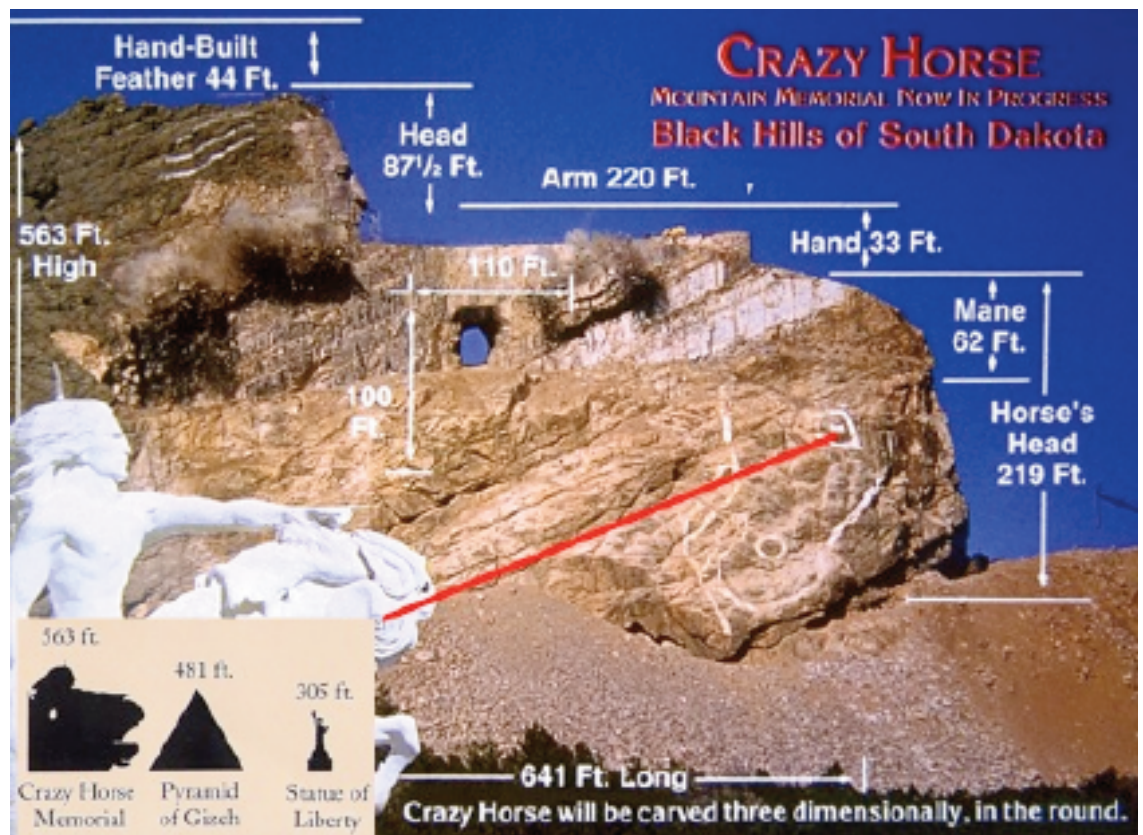


Figure 1 Demonstrates the immense size of the Crazy Horse monument located only 18 miles from Mt Rushmore in the Black Hills of South Dakota

## President's Notes

William Cussen, P.E., LEED AP



As we wind down the Holiday Season I would like to wish all of you Happy Holidays and a Prosperous New Year. The New Year is going to start quickly for the Section with the Future Cities competition on January 21, 2012 at the University of Illinois at Chicago; anyone wishing to be involved with Futures Cities should contact Matt Miller at [mamiller@hntb.com](mailto:mamiller@hntb.com).

## ASCE Illinois Section News

**ILLINOIS SECTION NEWSLETTER**  
Mailed to all ASCE-IS dues-paying members  
American Society of Civil Engineers  
Illinois Section – Region 3

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call 1-800-548-2723

Web Site: <http://www.isasce.org>

### ASCE National Information

Phone: 1-800-548-ASCE  
Web Site: [www.asce.org](http://www.asce.org)

The Section was informed this past month that we have received partial funding from ASCE National for two very important Section items. The first item is our contract with Strategy Consulting Group to represent the various Illinois Sections of ASCE in Springfield. We requested a grant to fund their entire contract, but due to the large number of requests that National received only half of the contract was funded. We will be asking other Illinois Sections for funding to allow us to either fund other activities or amend Strategy Consulting Group's contract to cover new legislation affecting Engineers. The second item is our annual visit to Springfield to meet with our elected officials. Darren Olson and Lou Arrigoni will be working with Strategy Consulting Group to determine the best dates. Look for more information in next month's newsletter and let's start making plans for a trip to Springfield to visit our elected officials.

Along with the Section's visit to Springfield this year, National has started planning their annual Fly-in to Washington D.C. The dates of the Fly-In this year are March 20th through March 22nd. ASCE Staff will brief the attending Section Members about the current legislation in Washington. Our group will then visit our Illinois Senators to discuss the legislation, then we will visit our individual Representatives and their staff to discuss the legislation with them. The National Staff does a great job at getting meetings scheduled with both Senators and Representatives, allowing us to meet with leaders and not just drop off information in their offices.

The one item that can sometime be lost in all of the time spent visiting with the elected officials in Springfield, Washington

or even in our local communities is that we need to continue to let the elected official know we are out there. We sometimes make it easy on the elected officials to dismiss our visits as something that is being coordinated by an association, by not following up with

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them in some manner after our visits. There are many ways to follow up with the elected officials from e-mails, phone calls or even visiting the local offices of the officials when they are back in their districts.

On a sad note, this past month our long time Section Secretary, Barb Pries, passed away. Barb was the Section Secretary from 1983 until she retired in 2008. On behalf of the Illinois Section I offer our sincere condolences to the Pries' family.

We hope you all have a safe and happy break from the workplace, and look forward to a strong 2012! **ASCE**



# Carving of the World's Largest Rock Monument

(continued from page 1)

buried". A few statistics underscore the immensity of this monument. More than 1000 visitors stand on the out stretched arm during the annual "Volksmarch". Crazy Horse's head can hold all four heads in Mt Rushmore. Carving such a massive monument is akin to erecting a European cathedral in the Middle Ages; it takes a long, long time. Begun in 1948, the 90 foot high face was not completed until 1998, 50 years later.

Carving a 500 foot plus high monument requires careful planning to provide access as well as a great deal of rock blasting. However, there is a lot more to it than chipping away the rock until the Indian and horse are found. First, weathered rock was removed to expose the face and arm as shown in Figure 2 by the green lines on the photograph of the first blast. Then the tunnel was excavated beneath the Crazy Horse's arm to highlight the arm and to provide access from the backside to the inclines and benches for the drilling and loading of the blast holes. At this point, in 1994 some 3.7 million cubic yards of rock had been removed by blasting, while all of Mt Rushmore required removal of only 0.5 million cubic yards. Blast removal requires some 5 stages: mass blasting to produce

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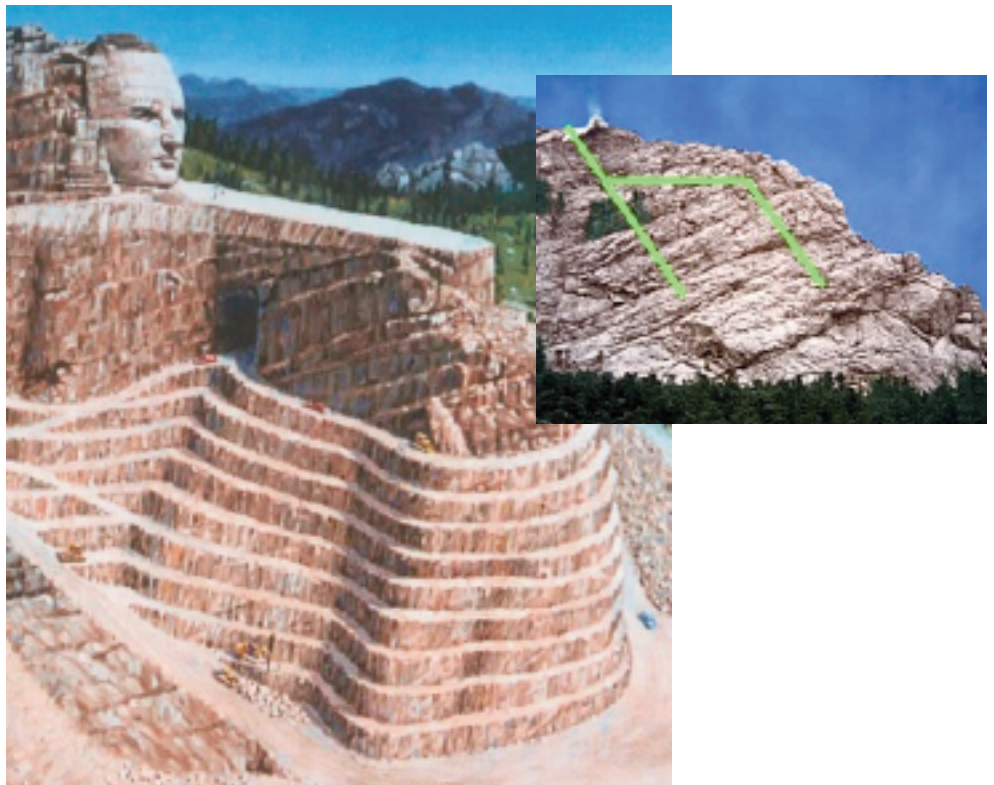


Figure 2 The larger painting illustrates the provision of access for drilling by a series of ramps and benches compared to the first blast in 1948 at the top of the mountain shown in the inset. The right side of the green outline in the inset defines the large volume of rock removed to establish the carving volume as far below the zone of weathering as possible.

benches, which are then blasted to within 20 feet of the final surface by specifying an allowable peak particle velocity of 3 inches per second (ips) at the surface of the finished carving. This benching stage is shown by the planning painting in Figure 2. The final three stages are removal of the buffer to within 3 to 4 feet, careful removal of the remaining 3 feet by blasting with detonation cord, and final smoothing with a 3300°F (or 1800°C) plasma torch.

## Rock Blasting

Rock blasts to isolate the Crazy Horse's nose and expose his lips shown in Figure 3 provide examples of the high degree of control possible with careful

blasting. Cross sections of these two blasts are outlined by the dotted yellow lines. The right inset shows the drill-hole geometry of the closest blast while the left inset shows the results of the larger blast. Note how the rope supported drilling platforms were not displaced during detonation of the larger blast.

Controlled blasting involves a great deal of drilling, just as painting requires a great deal of preparation. The larger 22 x 25 ft high slab was first isolated from the nose by melting a 6 inch thick by 22 ft long slot with a 3300°F (or 1800°C) plasma torch to prevent explosive gas pressures from entering the rock through joints in the nose. Then

(continued on page 4)

# Carving of the World's Largest Rock Monument

(continued from page 3)

as shown in the right inset, horizontal holes were drilled at 6 inch centers in 11 ft pairs to maintain parallelism. These holes were loaded with 50 grain per foot detonating cord (50/7000 lb per foot) and stemmed with silica sand to prevent discoloration of the remaining rock.

The shot was broken into 11 separate explosions by detonating groups of 4 rows of paired holes at 9 millisecond intervals. These 11, ½ lb, explosions, which sound as one and appear as one in the figure produced less than 3 ips at the nose. Miniature computer chips within the blasting cap detonators now control the blast timing to within 1 part in 10,000. This recent, revolutionary advance also inhibits terrorism as now an "ID" and password are required to fire an electronic detonator.

## Rock Mass Support

Unlike its gray granite neighbor, Mt Rushmore, Crazy Horse and his mount are being carved out of an appropriately colored, pinkish, granitic pegmatite shown in inset in Figure 4. While intact specimens of the pegmatitic granite are stronger than high strength concrete, what is important for stability is what isn't rock; the joints. This particular fin of rock is intersected by a strongly persistent and heavily weathered joint set shown by the arrows in Figure 4. They may have been induced either during the initial intrusion or during uplifting. Subsequent weathering has stained them brown. They provide a weak surface to which blasting can conveniently break the rock as shown by the control these joints exercise on the bench tops. Another set of joints, oriented perpendicular to this major joint set, can combine with the newly

(continued on page 5)

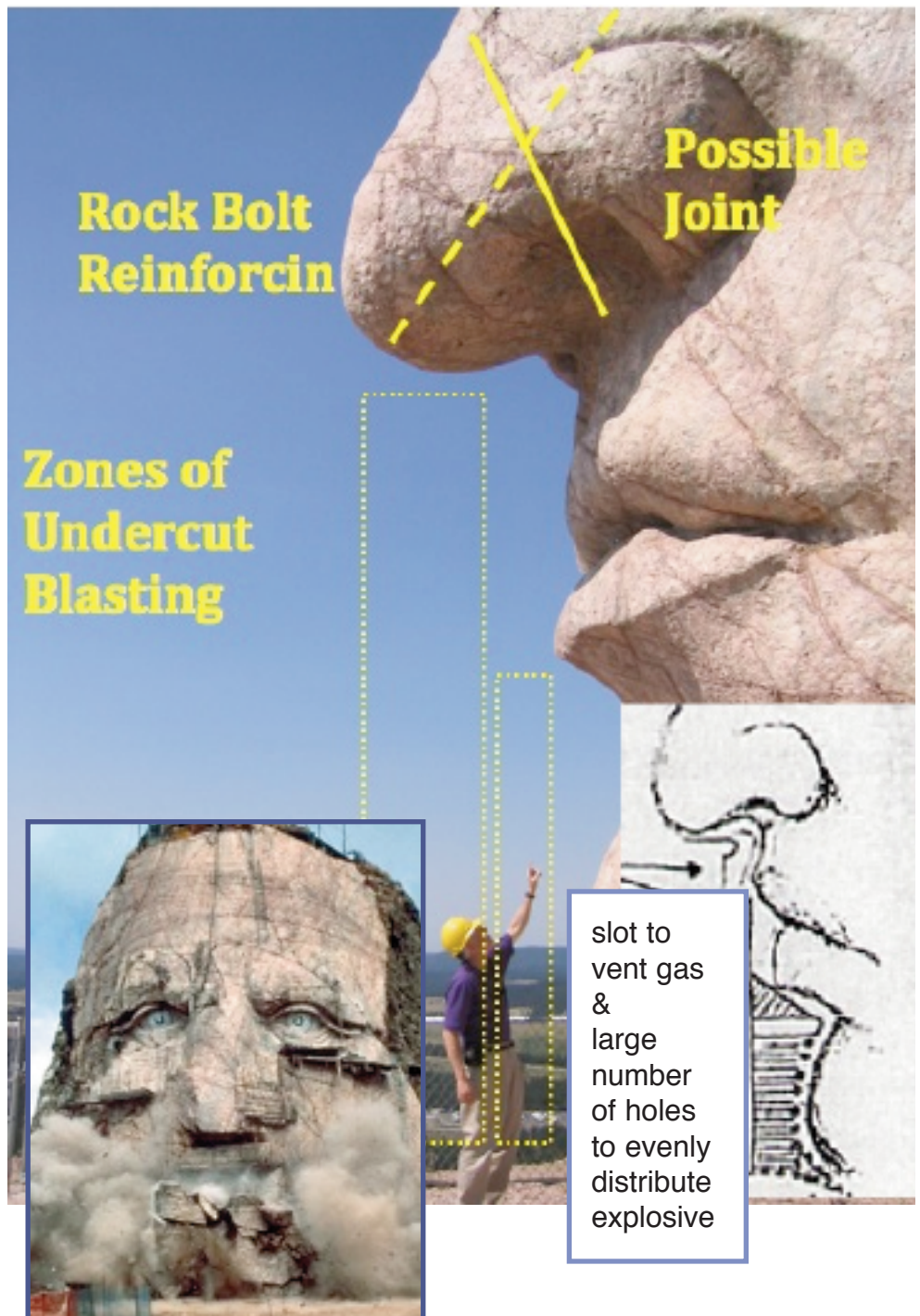


Figure 3 Final carving involves sophisticated blasting techniques combined with rock reinforcement to maintain a fracture free final surface. Right most inset illustrates use of a slot to vent gases and closely spaced holes to evenly distribute a small amount of explosive over a large area.



# Carving of the World's Largest Rock Monument

(continued from page 5)

carved surface to define blocks that can move independently of each other unless locked into the mass by “key blocks” or reinforcement.

Movement along joints can be prevented by reinforcing and rock bolts. For example, reinforcing for the Crazy Horse's nose is shown by the yellow lines in Figure 2. More than 20 steel rods were grouted into holes drilled across possible joints (solid line in the figure) to ensure that the immediate blasting would not permanently displace the rock along the joint induced planes of weakness. They were all strategically placed by first mapping the joints on the rock surface and then drawn in CAD for three dimensional control and orientation. This same procedure will be followed during the final blasting for the details of the horse's head. Reinforcing for the arm will be

more challenging because of its size and the desired length of its unsupported span. The persistent, brown stained joints present the greatest challenge as shown in Figure 4.

Many grand rock mechanics challenges remain as the monument approaches its final size. Although the carving of the final surface is years and perhaps decades away, planning has already begun to meet these challenges. First the entire monument will be blocked out to within 20 feet to identify the critical joints and to allow closer examination of their properties. This step will allow the analysis and computer modeling of the rock mass behavior with the best of possible data prior to carving the final surface. Several other steps have been taken to ensure overall stability. The painting in Figure 2 shows that the blocking of the horse's head is not

The art of sculpture and monument carving and the science of rock mechanics and engineering must fully embrace each other.

following the profile of the overhanging forehead. This face is being excavated with a slightly outward tilt to ensure stability of the 220 foot high head. The Chief's arm has remained fully supported while the effect of the intersecting persistent joints is analyzed.

The project has reached the stage where the art of sculpture and monument carving and the science of rock mechanics and engineering must fully embrace each other. The realities of the joint-induced weaknesses in the rock mass will have to be considered while respecting the artistic integrity and original intent of the artist. This combination of art and science has already led to the carving of a world class tribute to the Native American spirit. Continued interplay will produce a finished monument that, as Korczak Ziolkowski the sculptor would say, “maintains the legends so that there will always be greatness.” **ASCE**

Charles H Dowding, Ph.D., P.E. M.ASCE is a Professor in the Department of Civil & Environmental Engineering at Northwestern University in Evanston, IL. He is the author of four books in the areas of blast & construction vibrations, Time Domain Reflectometry, and micrometer measurement of crack response. He can be reached at [c-dowding@northwestern.edu](mailto:c-dowding@northwestern.edu). Further information about Crazy Horse can be found at [www.crazyhorsememorial.org](http://www.crazyhorsememorial.org). This article was provided by the Geo-Institute Illinois Chapter.

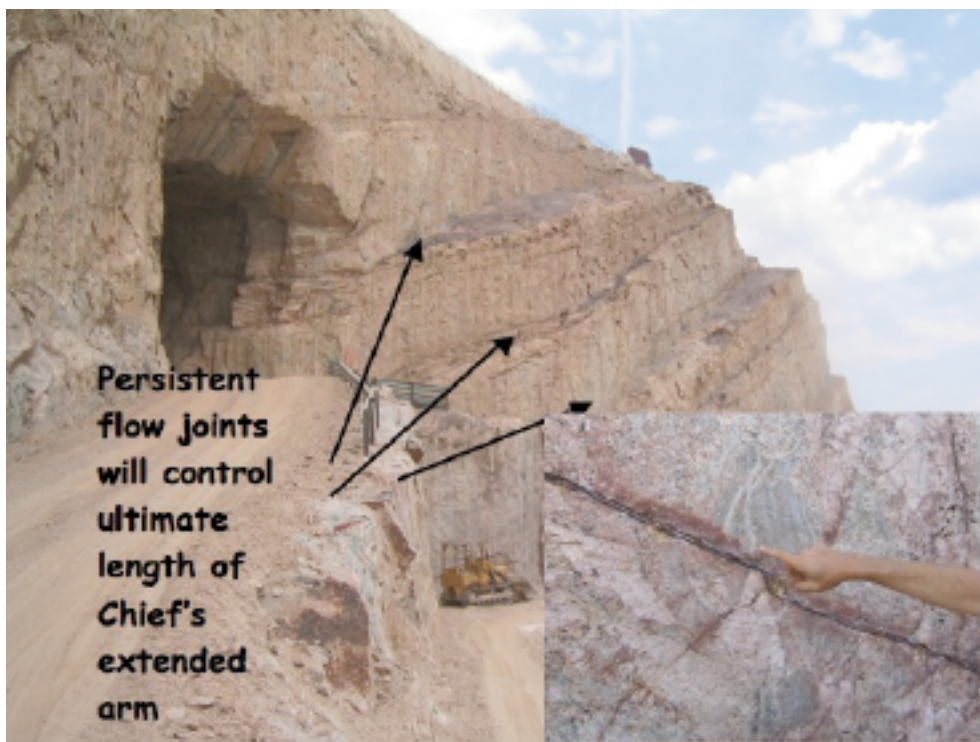


Figure 4. The rock is a reddish-pink granitic pegmatite containing xenoliths left over from the intrusion. The most prominent discontinuities that control the behavior of the rock mass are the persistent, brown stained joints, which can be seen to control horizontal blast induced fragmentation.

## Section Activities

J A N U A R Y

### Chicago EWRI Chapter

#### Monthly Meeting

**Date:** Tuesday, January 10  
**Time:** 5:30 pm  
**Place:** MWH  
175 W Jackson Blvd, 19th Floor  
Chicago, IL 60604  
*Use elevator banks on the  
Van Buren side of the building.*  
**RSVP:** Arun Herr at  
[Arun.K.Heer@usace.army.mil](mailto:Arun.K.Heer@usace.army.mil)

### TD&I

#### January Board Meeting

**Date:** Tuesday, January 10  
**Time:** 5:30 pm  
**Host:** Mukul Pal - HDR  
**Place:** HDR Engineering  
8550 W Bryn Mawr Ave # 900  
Chicago, IL  
**RSVP:** By Monday January 9th to Mukul  
Pal at [mukul.pal@hdrinc.com](mailto:mukul.pal@hdrinc.com)  
*Any ASCE Member is welcome  
to attend*

### Future City Competition

#### Computer Model & Essay Pre-Judging

**Date:** Saturday, January 14  
**Time:** 7:00 am to 12:00 pm  
(breakfast provided)  
**Place:** HNTB Corporation  
111 N Canal St, Suite 1250  
Chicago, IL 60606  
**Contact:** Don Wittmer at  
[dwtittmer@hntb.com](mailto:dwtittmer@hntb.com)

### SEI-IL

#### January Dinner Meeting

**Date:** Wednesday, January 18  
**Time:** 5:30pm Cocktails  
6:00pm Dinner/Presentation

**Topic:** Diaphragm Seismic Design  
Methodologies for Building  
Structures  
**Speaker:** S. K. Ghosh, Ph. D.  
President  
S. K. Ghosh Associates Inc.  
**Place:** Pazzo's  
311 S. Wacker Drive  
Chicago, IL 60606  
**PDH:** 1 Hour  
**Cost:** \$40  
\$30 government/education  
\$20 fulltime students with RSVP  
on/before January 13, 2012  
\$45 without/late RSVP  
**RSVP:** By Friday, January 13th to  
[asce.il.struct@gmail.com](mailto:asce.il.struct@gmail.com)  
**Questions:** Contact Brett Sauter at  
(773) 775-4009

### Younger Member Group

#### Dinner Meeting

**Date:** Wednesday, January 18  
**Time:** 5:30 pm Dinner  
6:00pm Presentation  
**Topic:** Chicago Green Alley Program  
**Place:** HNTB Corporation  
111 N Canal St, Suite 900  
Chicago, IL 60606  
**PDH:** 1 Hour  
**Cost:** Professionals - \$20 each  
Students - FREE!!  
**RSVP:** By Monday, January 16th to Shawn  
Murphy at [sjmurphy@hntb.com](mailto:sjmurphy@hntb.com) or  
312-798-0297

### Future City Regional Competition

#### Judging, Awards, and Recognition

**Date:** Saturday, January 21  
**Time:** 8:00 am to 12:00 pm for  
Preliminary & Special Awards  
Judging (breakfast provided)

12:00 pm to 3:00 pm for Final Judging,  
Awards, Recognition  
*(not required but lunch provided  
if you wish to stay)*  
**Place:** University of Illinois at Chicago –  
Student Center East  
*Halsted, between Harrison & Taylor*  
**Contacts:**  
Preliminary Judging  
Aruch Poonsapaya at  
[aruchp@sbcbglobal.net](mailto:aruchp@sbcbglobal.net)  
Special Awards Judging  
Matt Miller at  
[mamiller@hntb.com](mailto:mamiller@hntb.com)  
Engineer Mentor to a team  
Don Wittmer at  
[dwtittmer@hntb.com](mailto:dwtittmer@hntb.com)

The Future City Competition is a national, project-based learning experience where students in 6th, 7th, and 8th grade imagine, design, and build cities of the future. Students work as a team with an educator and engineer mentor to plan a city using *SimCity™ 4 Deluxe* software; research and write solutions to an engineering problem; build tabletop scale models with recycled materials that showcase the unique aspects of their city; and present their ideas before judges at the Chicago Regional Competition in January. Regional winners compete at the National Finals in Washington, DC during National Engineers Week in February.

This outreach program introduces the students to career options in Science, Technology, Engineering, and Mathematics. ASCE has supported this program for many years and is recruiting volunteers to serve as judges for the student cities. Each city will receive an overall score during the preliminary judging rounds, and will also be evaluated for several specialty awards offered by industry organizations such as ASCE YMG. For more information, please visit the Future City Chicago website at <http://www.futurecitychicago.org/>.

*(continued on page 7)*

## Section Activities

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### Chicago EWRI

#### Technical Workshop

**Date:** Wednesday-Thursday,  
January 25-26

**Topic:** EPA SWMM 5.0 Workshop

**Place:** Region 5 EPA  
77 W Jackson Blvd  
Chicago, IL

**Cost:** \$1,000 general  
\$800 ASCE or EWRI Members  
\$700 Government Employees

**RSVP:** By Friday, January 6th at  
<https://www.123signup.com/registration?id=ccdgc> or contact  
[muneer.alie@epa.gov](mailto:muneer.alie@epa.gov)

### ASCE 2012 Student Resume Book

The ASCE Illinois Section will be publishing its Second Annual Student Resume book in early 2012. Members of the ASCE Student Chapters at the Illinois Institute of Technology, Northwestern University and the University of Illinois at Chicago are encouraged to submit one-page resumes in a standard business format by February 1, 2012. The book will be available upon request to dues paying Illinois Section Members.

Include an "objective" statement in your resume that explains if you are seeking a summer internship or a full-time job. Do not include your street address or other information that you would not wish to be viewed publicly. By submitting your resume, you are granting legal permission for ASCE to use your resume for the stated purpose. If you are interested in having your resume included in the book, or have any questions, please email your resume to me in MS Word format at [Greenjg@halcrow.com](mailto:Greenjg@halcrow.com).

John G Green, Pd.D P.E.  
IS-ASCE Director

## Upcoming Activities

### UIC Spring 2012 Engineering Career Fair

**Date:** Wednesday, February 22

**Time:** 12:00 pm to 4:00 pm

**Details:** The Engineering Career Fair is an effective resource to match potential employers with engineering students, not only for internships and co-op positions, but also for full-time careers. The UIC College of Engineering is recognized for its academic excellence with undergraduate and graduate programs in six academic departments.

**Place:** Illinois Room  
Student Center East  
750 S. Halsted Street  
Chicago, IL 60607

**Registration:** Early-bird discounted registration is now open, and will end at the close of business, on Tuesday, December 15, 2011. The employer registration link is:  
<http://www.ecc.uic.edu/ECC/EmployerRegistration>

**Questions:** For more information, please contact the Engineering Career Center at [engrjobs@uic.edu](mailto:engrjobs@uic.edu).

### SEI-IL

#### Student and Young Professionals Program for Structures 2012 Congress—Save the Date

**Date:** Thursday-Saturday, March 29-31

The ASCE/SEI Structures Congress is your annual opportunity to broaden your technical knowledge, sharpen your business skills, deepen your understanding of cutting-edge research, and network with your peers and colleagues. The 2012 program will include 11 concurrent technical tracks that focus on the theme: "*Forging Connections in the Windy City*." The sessions will demonstrate processes and present projects that are redefining structural engineering in the areas of bridge

and transportation structures, buildings, and advances in research. You will exchange ideas with your peers and learn how other companies have adapted to changes in today's global economy. The Congress presents a tremendous opportunity to earn PDH's and gain new knowledge so that you and your business will thrive. For more information, please visit the web pages below both for students and professionals.

#### For Students:

<http://content.asce.org/conferences/structures2012/student.html>

#### For Young Professionals:

<http://content.asce.org/conferences/structures2012/younger-member.html>

### President Elect and Student Scholarship Spring Dinner

#### Save the Date

**Date:** Wednesday, April 11, 2012

**Place:** Maggiano's  
111 W. Grand Ave.  
Chicago, IL

## ASCE Region 3 Activities

### Earthquake Induced Ground Motion

#### Structural and Geotechnical

Jan 19-20 Chicago, IL

### Pumping Systems Design for Civil Engineers

#### Hydraulics & Water Resources

Feb 9-10 Chicago, IL

### Progressive Collapse Mitigation: Practical Analysis Methods and Proven Solutions

#### Structural

Feb 23-24 Minneapolis, MN

## Illinois Section News & Secretary Report

D E C E M B E R 2 0 1 1

In an effort to inform Illinois Section members of the discussions at the monthly Board meetings, the Section Secretary contributes this monthly article to the newsletter. Any questions or comments on the Board activities are welcome by contacting Patrick Lach, at [plach@heyassoc.com](mailto:plach@heyassoc.com)

### ■ Treasurer's Report

▲ Treasurer MacKinnon presented the Treasurer's Monthly Report.

### ■ Group Reports

▲ All Groups presented a written report outlining previous and current month's activities.

### ■ New Business

▲ **UIC Funding Request:** The Section approved \$1,000 to the UIC Student Section for their participation in the Annual Great Lakes Conference. The funding approval is contingent on the Student Section giving a presentation after the conference.

▲ **Section Taxes:** The Section is determining what IRS forms are required to be submitted annually.

▲ **IIT Rice Campus EWeek:** The Section approved \$250 for supplies for the Section's participation in this event.

▲ **Student Scholarship and President-Elect Spring Dinner:** The dinner will be held on April 11, 2011 at Maggiano's in Chicago.

▲ **Barb Pries:** The past executive secretary of the Section passed away and the Section is sending flowers to the family.

▲ **Washington Fly-In:** The President, President-Elect and Past President will be attending the Washington Fly-In on March 20-22, 2012.

### ■ Old Business

▲ **SPAG Grant:** The Section was awarded \$3,750 for the lobbying activities and \$500 for the legislative drive-in.

▲ **E-Room:** The Section will be reorganizing the E-Room to facilitate better use of its capabilities.

▲ **Student Resume:** The Section is hosting a student resume book for the three student chapters.

The next board meeting is scheduled for Monday, January 9, 2011 at 5:30pm at MWH Americas, Inc., 175 West Jackson Blvd, 19th Floor.

By Patrick Lach  
[plach@heyassoc.com](mailto:plach@heyassoc.com)

### Dear EWB Members, Colleagues, Friends and EWB-CPC Supporters:

The Chicagoland Professionals Chapter of Engineers Without Borders ("EWB") would appreciate your support of our current fundraising campaign. EWB-USA, will match donations that our chapter receives by January 15, 2012, dollar-for-dollar until its matching funds are exhausted. EWB-USA will also award bonuses of \$5,000 to the chapter with the most donors and \$5,000 to the chapter that raises the most money by January 15, 2012.

Please support our chapter one of the following ways:

- donating on-line at:  
<https://ssl.charityweb.net/ewbusa/yearend.htm>
- sending a check to EWB-USA with the attached "Donate by Mail" form, or
- sending a check payable to EWB-USA to me and I'll do the rest

If you choose to donate, please allocate the funds to the Chicago Professionals Chapter and donate today—before the matching funds run out.

If we act QUICKLY every donation can be doubled and donations of any amount can help us win the bonuses!

More information about the programs that have made the Chicagoland Professional Chapter an EWB "Premiere Chapter" in 2011 and that we will continue to support with your contribution can be found [HERE](#)

Thank you for your support.

Sincerely,

Jeff Hamera