

Illinois Section

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Vol. 53, No. 6 July/August 2012

## The Role of Peer Review in the Foundation Design of the World's Tallest Buildings'

By Clyde N. Baker, Jr., P.E., S.E.; Tony A. Kiefer, P.E.

Peer review can be defined in general terms as the process of subjecting an engineer's work, research or ideas to the scrutiny of others who are experts in the same field. It is commonly used by editors to select and screen manuscripts or papers submitted for publication in technical or scientific journals. This article discusses the authors' experience in how the peer review process has been applied to the cost effective foundation design of some of the world's tallest buildings.

The goal of any foundation designer is typically to develop a design that is both cost effective and safe and meets any required settlement and performance criteria. If the peer reviewer's scope includes working with the design geotechnical engineering firm, in a collaborative as well as review role, maximum project benefits can result.

Peer review can be defined in general terms as the process of subjecting an engineer's work, research or ideas to the scrutiny of others who are experts in the same field.

#### Why Retain a Peer Reviewer

It is anticipated that retaining an appropriately experienced peer reviewer will help insure that there are no major engineering mistakes or issues overlooked and the appropriate effort has been made to develop both a safe and cost effective foundation design. Because geotechnical engineering on which the foundation design is based is a mix of art and science, reasonable differences of opinion among geotechnical engineers based on their different experiences and training can be expected. Such potential differences can result in widely different foundation costs and performance. Appropriate peer reviews thus offer the potential to reduce both foundation costs and risks of poor foundation performance.

A possible stage time line for peer reviews is as follows:

• Concept Designs

This is the best time for value engineering discussions so that all ideas for reducing cost may be considered early in the development stage.

• Subsurface Exploration and Laboratory Testing Program

Understanding and agreement on the level of effort exerted in this stage is important. There is a balance between the amount of

#### President's Notes W

William Cussen, P.E., LEED AP



Summer has arrived early this year with a scorching beginning to June. I hope everyone finds time to get away and relax a little bit this summer, because hopefully we will all be busy once again for a long time to come. It appears that Washington has come to an agreement on a new Transportation Bill; however, I have not seen the specifics at the



ASCE National Information Phone: 1-800-548-ASCE Web Site: <u>www.asce.org</u> time of writing these notes. I can only hope that it is a true long term Bill and not just another extension.

Although it is summer the Section is still working on a number of activities. One of these is a Committee of primarily Past-Presidents to review ideas to keep the Asian Carp out of Lake Michigan. The group will be reviewing the many infrastructure impacts of reversal from an engineering point of view to see if the solutions are logical, will cause more harm than good, and suggest additional analysis if needed. A couple of the ideas that have been suggested are; complete hydrologic disconnection of the Mississippi River and Great Lakes Basin, or even re-reversing the flow of the Chicago River. In Washington, an elected official from Michigan is pushing the Army Corps to review and act on these and other options to protect the fishing in Lake Michigan. While both of these options would create a substantial amount of work for our industry, they could also create larger problems in other areas. There is a substantial amount of economic impacts (as well as engineering impacts) if either of these options are instigated. Our Section's Infrastructure Report Card lists a substantial amount of activity, recreational and commercial, moving through the locks to access Lake Michigan. One big issue that needs to be investigated further is if there are any other ways that the carp can get into the Great Lakes.

During the first week of August the National Conference of State Legislators will be hosting their annual conference in Chicago, and ASCE National President Andy Herrmann will be speaking on the "Failure to Act" series. ASCE National will have a booth at the event and has asked for volunteers from the Illinois Section to be available to speak with the A very important item that has come up since our visit to Springfield in April is that IDOT has prepared and circulated an amendment that would change the QBS law to require engineering firms to have training and apprenticeship programs approved by the US Department of Labor.

legislators from Illinois. At the end of the first week the Region 3 Board of Governors will be hosting their "Annual Region 3 Assembly" and the Illinois Section will be providing speakers to discuss our legislative activities and about our Infrastructure Report Card.

One last and very important item that has come up since our visit to Springfield in April is that IDOT has prepared and circulated an amendment that would change the QBS law to require engineering firms to have training and apprenticeship programs approved by the US Department of Labor. This amendment did not come up in any Bills this spring; however it could come up at a later date. The amendment would apparently require the establishment of an Engineering Professionals union. The Section and our lobbyist will continue to monitor this amendment and will provide more information if this begins to materialize into a Bill. ASCE

## Legislative Update

By Darren Olson, P.E., CFM, D.WRE and Michelle Kelm

he General Assembly ended their spring session very late in the night of June 1st. It was a busy session and the Members did do a major overhaul of our Medicaid system, negotiated a charity care bill for the hospitals and once again passed gaming (whose fate is almost surely to be vetoed by the Governor). The last week or so of session was focused on Pension reforms. The two chambers had different thoughts on how to approach the issue, and things got pretty tense and heated during a few debates. They adjourned session without a pension fix. It is expected that we will come back into a special session to deal with the issue as soon as leadership can agree.

As a result of the many large issues each chamber found themselves with fewer "member" bills than in the years past. The Senate passed 208 bills to the governor and the House 252.

As a result of the many large issues each chamber found themselves with fewer "member" bills than in the years past. The Senate passed 208 bills to the governor and the House 252. That is far less than in the past—last year the House passed 468 bills. Luckily, the important legislation we were following continued to move forward. SB 3318 (Illiana) and SB 3216 (PPP) were both considered trailer bills by staff and were passed out and to the Governor's desk before Memorial Day.

The Illinois Dept. of Natural Resources had sweeping legislation to help keep the Dept. up and running. The Director of IDNR spoke at our Lobby Day on April 17th and talked about the importance of the legislation to help keep the Dept. doing what it is mandated by the state and feds to do. The bill was introduced late in session and was placed on a couple of bills before it was voted on as SB 1566. SB 1566 was very controversial because it had a number of fee increases. As a result, members who were considered targets were not allowed to vote on the bill, as well as members who see any fee increase as a tax increase. The bill failed to reach a majority in the House on the first try-but passed out on the second try with a vote of 61-56-0. The second vote came well into the day on the 31st. The Senate didn't take up the bill until after midnight, and because it had an immediate effective date the bill

required a 3/5 majority. The bill didn't receive a 3/5 majority and failed. There is a good chance the bill will be up for another vote if members come to Springfield for a special session.

The Budget bills we watched this session were the IDOT Budget Bill, Capitol Bill Re-Appropriation and Bond Re-Authorization.

The Budget bills we watched this session were the IDOT Budget Bill, Capitol Bill Re-Appropriation and Bond Re-Authorization. The IDOT budget bill is SB 2474. The Capitol Re- Appropriation is SB 2332 and the Bond bill is HB 4568. **ASCE** 

This article provided by Darren Olson, P.E., CFM, D.WRE, Chair of the Government Affairs Committee and Michelle Kelm of Strategy Consulting Group, consulting for Illinois Section.

#### **ASCE Needs You! Online Voting Is Now Open**

Illinois Section Past President Donald Wittmer, PE, M.ASCE is running for Region 3 Director. Please take a moment or two to support him by casting your ballot. Help shape the leadership of ASCE for 2013. This is your chance to make a difference by choosing officers you would like to lead ASCE.

## 2012 Chicago Geotechnical Lecture Series Attracts Record Number of Attendees

The 2012 Chicago Geotechnical Lecture was held on April 25th at the University of Illinois campus and it was organized by the Geo-Institute Chapter of the Illinois Section of the American Society of Civil Engineers. The theme of the lecture series was Earth Structures and Ground Improvement. Over 145 participants, including 24 students, attended the lecture series. There were 15 exhibitors who participated in the Lecture Series. The attendees received 7 professional development hours. The bi-annual Chicago Geotechnical Lecture Series (formerly called the Soil Mechanics Lecture Series) was established in 1962 to educate the engineering community and keep them informed of recent developments in geotechnical and geoenvironmental engineering.

The success of the 2012 Lecture Series is mainly attributed to the nationally and internationally recognized experts elucidating the current and emerging advances and practices in geotechnical engineering field. Speakers included Drs. Robert Holtz, William F. Marcuson, A.J. (Skip) Hendron, Donald Bruce and Russell Green.

The revenue from the Lecture Series is used to support annual scholarships to geotechnical engineering students in the Chicago area and support of student ASCE chapters for various student activities. The organizing committee would like to thank the participants and exhibitors for making this year's lecture series successful. **ASCE** 



Speakers: Drs. William F. Marcuson, Russell Green, Robert Holtz, Donald Bruce and A.J. (Skip) Hendron. Organizing Committee: Gary Goodheart, Julian Rueda, Dr. Rich Finno, Dhooli Raj, Kalyani N Devabhaktuni, Fran Miller, Dr. Krishna Reddy, (Not Pictured: Alan Levine and Dr. Tim Stark )

## The Nominating Committee is proud to present the following candidates for election to the Illinois Section Board next year:

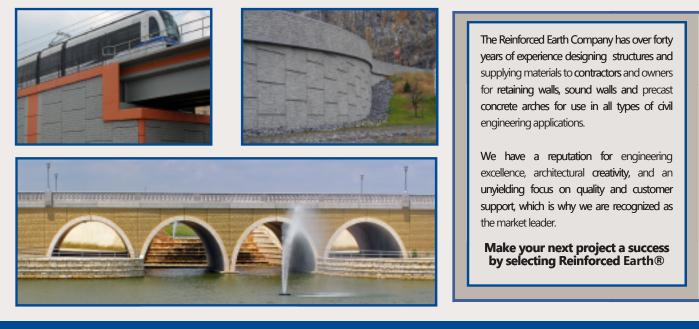
Secretary:

Thera Baldauf, P.E. - MWH Americas

Directors to 2014: Matt Huffman, P.E. - Christopher B. Burke Engineering, Ltd. John Green, P.E. - HALCROW/CH2M HILL John Lazarra, P.E. - HDR, Inc.

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#### The Role of Peer Review in the Foundation Design of the World's Tallest Building

(continued from page 1)

geotechnical information (field and laboratory) that can be obtained and the selection of the maximum geotechnical design criteria for most cost effective foundation design.

## • Periodic Desired Team Conference Participation

It is helpful if the peer reviewer can participate in the foundation design conference meetings/workshops along with the geotechnical engineer, structural engineer and construction manager. The possible need for site trips for site conferences must be considered and the cost included if desired.

• Interim Report Reviews

The peer reviewer should have the opportunity to review any interim reports or preliminary design recommendations as any questions or suggestions or disagreements can be discussed at that time with the design geotechnical firm with any modifications called for outlined in subsequent reports.

#### • Final Report Review

If the peer reviewer has been involved in the earlier stages as outlined above, the final report review amounts to a confirmation of what has already been agreed to.

## • Foundation Drawings and Construction Specifications

Since at this point all parties are in agreement with the foundation design, peer review is an opportunity to make any comments for improved clarity. If the peer reviewer has particular expertise and experience with the foundation system selected, a review of draft specification permits the opportunity for making any changes that might maximize clarity.

#### • Pile Load Test Results Review

Peer review of pile load test results may be particularly important in the event that changes in foundation design may be required. Poor results may require lengthening piles at significant cost or better than anticipated results may permit shortening piles for resulting cost savings.

## • Peer Review Services beyond Defined Scope

On occasion, when the peer reviewer has some particular expertise or experience that the design geotechnical engineer lacks, the peer reviewer's scope can be increased to include actual design work or specification development. This happened on one of the case histories described below.

#### Potential Problems with Peer Review

Critics of peer review have concerns that competitive jealousies could obstruct objectivity and lead to efforts aimed primarily at enhancing ones own image and prestige rather than enhancing the project goals. Granted that this is a concern to guard against, it hopefully has not occurred on the projects in which the authors have been involved.

#### **Case Histories and Results**

#### Burj Khalifa<sup>2</sup>

Burj Khalifa is the world's tallest building at the current time. Built in an area (Dubai) where the foundations consist of a relatively soft rock of variable strength and compressibility, the design geotechnical engineer brought on board an internationally recognized consultant to participate in the foundation investigation right from the beginning. In addition, the design architect and structural engineer retained their own geotechnical peer review consultant with whom they had many years of successful experience working together. Both peer review consultants were involved from the beginning of the investigation and participated in design review conferences either by phone or in person. Major issues for review were the rock properties to use in the design friction and bearing including the rock modulus for settlement prediction, the percent of load carried by the mat, and the length of piles required for adequate bearing capacity and tolerable settlement. Full scale pile load tests were used to confirm design assumptions. Through the process of the peer reviews it was possible to reduce the pile lengths modestly at significant cost savings. The pile load tests confirmed the conservatism of the design assumptions. With the building constructed and all load in place for more than two years, the observed settlements are below the most optimistic predictions of both the geotechnical design engineer and both peer review consultants.

#### Chicago High Rises

Along with New York (and now Dubai) Chicago is known as the skyscraper city where at one time the city had three of the four tallest buildings in the world. Chicago has lost its title as having the world's tallest building but is still building very tall buildings. In recent years the City has installed a peer review process which the developer actually pays for at least in part. In the geotechnical and foundation peer review section, the reviews have often been performed after the foundation investigation and geotechnical report have been submitted for final foundation design. When the peer reviewer disagrees with the geotechnical engineer at this late stage and may want additional work done, it can be embarrassing for the geotechnical engineer who has to go (continued on page 7)

#### The Role of Peer Review in the Foundation Design of the World's Tallest Building

(continued from page 6)

back to the owner or developer for additional funds and explain the required delays. Thus, this after-the-fact review is much less desirable than reviews which can be made early enough to be included in investigation cost projections. Efforts are now made to involve the peer reviewer at an earlier stage for his input if it should differ from the design geotechnical engineer's. Usually with the recent tall building projects, variances are required to exceed code values. This makes it even more important to involve the peer reviewer early on with the request for code variance. ASCE

Tony A. Kiefer received his B.S.and M.S. degrees in engineering at the University of Illinois. He has over 27 years experience in foundation engineering. As a Principal Engineer at AECOM, Mr. Kiefer has been responsible for more than 50 high-rise buildings in Chicago and consultant for some of the world's tallest buildings such as the Kingdom Tower, Busan Lotte Tower and the Doha Convention Center and Tower.

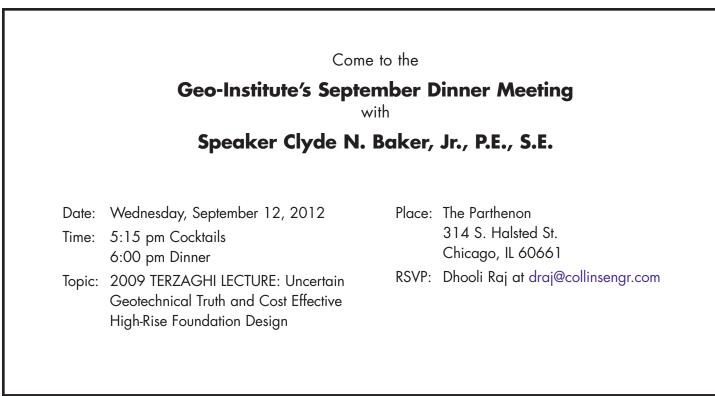
Clyde N. Baker, Jr. graduated with a B.S. Degree in Physics from William and Mary College in Virginia and with both B.S. and M.S. in Civil Engineering from M.I.T. Over the past 57 years he has served as the geotechnical engineer or consultant on most of the high rise buildings in Chicago and eight of the twenty tallest buildings in the world, including the Petronas Towers and Burj Khalifa. In 2009 he presented the The Terzaghi Lecture entitled "Uncertain Geotechnical Truth and Cost Effective Foundation Design"

This article provided by the Geo-Institute.

#### **References and Acknowledgements**

<sup>1</sup> Excerpt from: BAKER, C. & KIEFER, T (2008). The Role of Peer Review in the Foundation Design of the World's Tallest Buildings. Published in WOOD, A. (ed.) (2008). Tall & Green: Typology for a Sustainable Urban Future. Proceedings of the CTBUH 8th World Congress, 3rd-5th March 2008. Dubai, UAE. Published by the Council on Tall Buildings and Urban Habitat, Chicago. 869 pages, hardback. ISBN: 978-0-939493-25-8

<sup>2</sup> Burj Khalifa: Architect/Engineer: Skidmore, Owings & Merrill LLP, Local Consultant: Hyder Consulting Middle East Ltd., Client: EMAAR Properties, Contractor: Samsung-BESIX-Arabtec, Geotechnical Engineer: Hyder Consulting, Ltd., Construction Manager: Turner Construction International



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- Al Truss, President, Fountainhead Group Consulting, Ltd. BillQuick user

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HANNERSD .	Schematic Design	\$4,00.00	35		\$240	\$4000.00
111.00812200	Design Development	\$4,000.00	375		\$0.00	\$1,200.00
11-1.0001030020	Contraption Decomputer	\$25,000.000	18%		\$20.00	\$1,000.00
HURBICA	Contraction Administration	\$12,000.00	9%		\$0.00	\$100.80
	TOTALS	54.400.00		_	\$0.00	57.40500
Consultant Fees;						
Desiration Stratical Lagrant Pergena (1)		15.2	61	100	Same res	Accuse SLORDO
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## Section Activities

#### JULY/AUGUST

#### T&DI

Luncheo	n Program
Date:	Monday, July 9
Time:	11:30 to 12:00 Social 12:00 to 12:40 Lunch 12:40 to 1:30 Speaker
Speaker:	John Fortmann Acting Deputy Director Region 1 Engineer
Place:	Maggiano's 1901 E. Woodfield Rd. Schaumburg, IL 60173
PDHs:	1.0 Hour
Cost:	\$45 ASCE \$50 Non-members \$35 Government \$15 Students
RSVP:	By Friday, July 6th at https://www.123signup.com/event?i

Questions: Brian Pawula at <u>brianp@thomas-engineering.com</u> or (847) 922-6125

#### Chicago EWRI

#### Annual Summer Social Meeting

- Date: Tuesday, July 10 Time: 5:30 pm Place: Park Grill @ Millennium Park 11 N. Michigan Ave Chicago, IL 60602
- RSVP: Gary Paradoski gary.paradoski@mbakercorp.com

## Urban Planning & Development Group

July Dinner Meeting		
Date:	Wednesday July 11	
Time:	6:00pm to 7:30pm	
Topic:	TBD	

- Place: Dave and Busters (1-355 at Lake Street) 1155 N. Swift Road Addison, IL 60101
- Cost: \$25 Make checks payable to ASCE UP&D
- RSVP: Michelle Lipinski, michelle.lipinski@rubinoeng.com

#### T&DI

#### **Board Meeting**

- Date: Tuesday, July 17
- Time: 5:30pm Place: T.Y. Lin International 200 S. Wacker Dr., Suite 1400 Chicago, IL 60606
- RSVP: By Monday, July 16th to host Shane Schneider at <u>shane.schneider@tylin.com</u>

(Any ASCE member is welcome to attend.)

#### **IS-ASCE**

2012 Award Nominations Due Additional information and forms are available at <u>http://www.isasce.org/web/</u> awards.html

#### SEI Illinois Chapter/Geo-Institute

#### July Training Seminar

Date:	Thursday, July 26
Time:	8:00 am to 5:00 pm
Topic:	Design and Construction of Steel Sheet Piling Structures Seminar
Speaker:	Richard Hartman, Ph.D., P.E. Hartman Engineering
Place:	200 West Adams Street 14th Fl Conference Rm Chicago, IL 60606

- PDHs: 7 Hours
- Cost: \$200 before July 13 \$300 - after July 13 \$50 - Student Members
- RSVP: By Friday July 13th at https://www.123signup.com/register?id=svytn
- Questions: Richard Morales at (678) 714-6730 x103 or <u>RMorales@LBFoster.com</u>

#### T&DI

Board Meeting		
Date:	Tuesday, August 14	
Time:	5:30pm	
Place:	Christopher B. Burke Engineering, Ltd. 9575 W. Higgins Rd., Suite 600 Rosemont, IL 60018	
RSVP:	By Monday, August 13th to host Matt Huffman at <u>mhuffman@cbbel.com</u>	

(Any ASCE member is welcome to attend.)

#### **UPDG/Fox Valley USGBC**

#### In-Person Webinar #2

Date:	Thursday, August 16
Time:	6:00 pm to 7:30 pm
Topic:	LEED for Neighborhood Development: A Tool to Retrofit the Suburbs (Recorded USGBC Webinar)
Place:	Engineering Enterprises, Inc. 52 Wheeler Road Sugar Grove, IL 60119
PDHs:	1.5 Hours + 1.5 LEED Specific GBCI hours
Cost:	\$10 – use code ASCE2012 \$25 at the door
RSVP:	http://admin.usgbc- illinois.org/widget/calendar?eventId=46 0276&EventViewMode=2&Calendar ViewType=1&SelectedDate=8/14/2012

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#### **Section Activities**

(continued from page 9)

#### **Upcoming Activities**

#### Geo-Institute

#### **Dinner** Meeting

Date:	Wednesday, September 12
Time:	5:15 pm Cocktails, 6:00 pm Dinner
Topic:	2009 TERZAGHI LECTURE: Uncertain Geotechnical Truth and Cost Effective High-Rise Foundation Design
Speaker:	Clyde N. Baker, Jr., P.E., S.E.
Place:	The Parthenon 14 S. Halsted St. Chicago, IL 60661
RSVP:	
KSVP:	Dhooli Raj at <u>draj@collinsengr.com</u>

#### 2012 ASCE Illinois Section Annual Dinner Meeting

#### SAVE THE DATE!

Date: Wednesday, October 10, 2012

Join us for a special night of celebrating outstanding engineers and projects that have made a difference in Illinois!

Place: Union League Club 65 W. Jackson Chicago, IL 60604

#### Other Organizations' Activities

#### Northwestern University Lecture

Date:	Wednesday July 11
Time:	7:30 to 9 am
Topic:	Casinos: LEED Gold and
	Urban "Gold"

The recent trend to locate casinos in major cities—how that is evolving, creating jobs, and redistributing gaming revenue geographically—will be the focus of this presentation. Illustrating this trend will be a case study discussing the unique features of Illinois' newest casino in Des Plaines, and the attributes that qualified it to be the first LEED Gold casino. Also discussed will be the casino's parking structure and how it contributed to the LEED Gold rating with its Parking Guidance System (PGS) and 100% LED lighting, reducing energy consumption by 40%.

Speakers: Charles C. Porter, Principal Development Management Associates Eric Bullion, Project Executive, Pepper Construction Company Bradley F. Navarro, Project

Manager, Walker Parking Consultants

Place:	Feinberg School of Medicine
	Northwestern University
	Lurie Building / Searle Conference
	Room
	303 East Superior, First Floor
	Chicago
<b>RSVP</b> :	By noon Monday, July 9th
	to EMDC@northwestern.edu

#### Northwestern University Lecture

Date:	August 15, 16, and 17, 2012
Topic:	Symposium on Technology for Design and Construction

HYPERMODELING, AUGMENTED REALITY, and BIM-WORKFLOWS

In addition to a great opportunity to network with the giants in this field, this Symposium will address the exciting challenges posed by the fast-moving technological advancements in our industry and provide answers to many of the questions raised by users.

Place:	Northwestern University Law
	School in downtown Chicago.

**RSVP** and Details:

http://www.techforconstruction.com

### Illinois Section News & Secretary Report

#### J U N E 2 0 1 2

n 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

#### Treasurer's Report

▲ Treasurer MacKinnon presented the Treasurer's Monthly Report.

#### ■ Group Reports

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

#### New Business

▲ The Illinois Institute of Technology Student Section gave a presentation about their participation in various events in the Great Lakes Regional Conference. The Illinois Section sponsored the IIT Student Section for this event.

▲ The Northwestern University Student Section gave a presentation about their participation in various events in the Great Lakes Regional Conference. The Illinois Section sponsored the NU Student Section for this event. In addition, the NU Student Section qualified to attend the National Steel Bridge Competition and requested funding to assist the Student Section. The Illinois Section approved a \$1,000 sponsorship to the NU Student Section. ▲ The Region 3 Summer Meeting will be held in Chicago and the Section will be in attendance.

▲ The Board is participating in a white paper discussion about re-reversing the Chicago River and is going to be submitting a letter to National ASCE.

#### Old Business

▲ Several Illinois Section and APWA members attended the Springfield Legislative Drive-In on April 17, 2012. Attendees were involved with meeting with State Senators and Representatives to discuss infrastructure and other engineering related bills and issues.

▲ Report Card: The Section presented the water and wastewater portions of the report card to AWWA on April 17, 2012 ▲ The 18th Annual ASCE Golf Outing will be held on May 24, 2012 at Maple Meadows Golf Course in Wood Dale

▲ President-Elect Dinner: The dinner was held on April 11, 2012 at Maggiano's in Chicago. President Elect DiLoreto gave a presentation about his vision for ASCE.

The next board meeting is scheduled for Monday, June 4, 2012 at 5:30pm at MWH Americas, Inc., 175 West Jackson Blvd, 19th Floor.

By Patrick Lach plach@heyassoc.com

#### Land Surveying Education in Chicagoland through Southern Illinois University Carbondale

Would you like to train yourself or your employees to become licensed Professional Land Surveyors? If yes, SIU Carbondale offers its high quality land surveying courses in the Chicagoland area for those who cannot attend SIU Carbondale fulltime. Along with the theoretical concepts, this program has a complete laboratory component where students learn the required field techniques and equipment used in today's practice. Generally, one course per semester is offered on weekends in the Fall, Spring, and Summer semesters. New students can now join the 24 credit hour sequence every summer by taking the Basic Surveying course. Those who have already taken an approved Basic Surveying course, or equivalent, can join the sequence in a Fall semester (Spring semester enrollments may be allowed depending on the pre-requisites).

Course offerings are subject to minimum enrollment requirements. If you are interested, please contact Mr. Brandon Edwards (bpedward@siu.edu) or Mr. Kyle Allred (kyallred@siu.edu) in the Department of Civil and Environmental Engineering, or call the Department at (618) 536-2368.