

# ARIZONA CivilView

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Spring 2009

## Robert Fleischman Leads Multi-University Team in \$2.8M Seismic Design Project

**D**r. Robert B. Fleischman, Delbert R. Lewis Associate Professor in the Civil Engineering and Engineering Mechanics (CEEM) Department at the University of Arizona, is leading a multi-university team in a \$2.8M research effort to develop a new seismic design methodology for floor diaphragms in precast/pre-stressed concrete structures.

Precast/pre-stressed concrete, where highly durable prefabricated units are rapidly assembled on site, is one of the most economic construction techniques in the U.S. However, vulnerability of the floor systems during earthquakes due to failure of the connectors between individual floor units, as evidenced by the collapse of nine precast parking structures in the 1994 Northridge (CA)



earthquake, severely limits the application of this method.

The Precast/Pre-stressed Concrete Institute (PCI) awarded the consortium led by principal investigator (PI) Fleischman and including co-PIs Dr. Jose Restrepo from The University of California-San Diego (UCSD) and Drs. Clay Naito and Richard Sause from Lehigh University (LU) to develop the new design methodology, focusing on “diaphragm” action, i.e. the ability of the floor system to hold the structure together.

The effort is jointly funded by PCI, the Charles Pankow Foundation (CPF), and the National Science Foundation (NSF); through both their Grant Opportunities for Industry Liaison with Academia (GOALI) Program and the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Consortium.

The researchers are using cutting-edge experimental techniques involving the integration of physical testing with model-based computer simulation to confront the complex problem of understanding the nonlinear dynamic response of the precast floor diaphragm. These experiments are only possible due to the next-generation testing capabilities afforded by the recently commissioned network of 15 NEES Equipment Sites, of which the laboratories at UCSD and Lehigh are included.

In 2005, full-scale tests of diaphragm connectors at LU suggested improved connector designs. UA graduate student Ge Wan (Ph.D. '07) used the test results in 2006 to develop advanced nonlinear finite element models of the precast floor system. These models were used to perform

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static “pushover” analyses to suggest the appropriate relative strengths of different reinforcement groups in the precast floor.

In 2007, the researchers performed experiments using adaptive or “hybrid” testing techniques, in which the majority of the structure is represented by a UA computer model and the key region of the structure (a critical floor joint) is represented by a physical test specimen at the NEES@ Lehigh structural laboratory. For these tests, current UA Ph.D student Dichuan

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The ARIZONA  
**Civil View**

Winter 2008 Issue

The *Civil View* discusses research, student activities and news of the Civil Engineering and Engineering Mechanics Department of The University of Arizona.

**Editor:**  
Serena Escalante

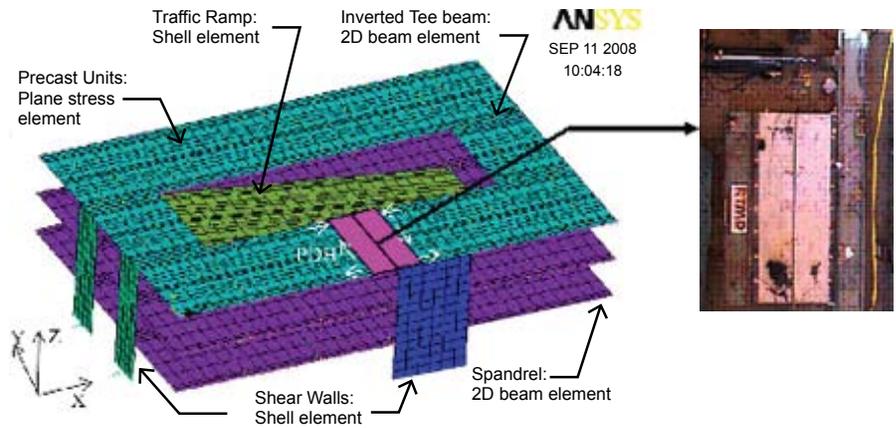
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*Thank  
You*

As noted on the cover, we are moving Civil View to electronic copies. This issue is made possible by the generous donation from Distinguished Alum Joe Gervasio of Gervasio and Associates.

**Thank you Joe!**



Zhang extended Dr. Wan's static model to accurately produce nonlinear degrading cyclic dynamic behavior, as is required to simulate the earthquake response of precast concrete diaphragms.

The UA earthquake simulations control the hydraulic actuators at the Lehigh laboratory while simultaneously reading sensor data from the test specimen. This closed feedback enables the computer model to respond accurately as the specimen accumulates damage, thereby subjecting the test specimen to the expected demands of a real earthquake. The tests were successful, showing excellent agreement between analytical predictions and experimental results, and indicating the efficacy of the improved details.



The experimental program culminated with a large demonstration test at the NEES@UCSD Large High Performance Shake Table at Englekirk Structural Engineering Center, the largest shake table in the U.S. The test specimen was a three-story precast concrete structure at half-scale designed with the emerging methodology. The one-million pound structure had the largest footprint of any structure ever tested on a shake table in the U.S.

The tests drew national attention,

including a media event attended by over 100 observers; the research team was interviewed by ABC World News, The Discovery Channel, the L.A. Times, Telemundo, and the local TV and radio news media; stories on the project have appeared in several science and engineering magazines and websites such as ASCE's Smart-Brief, PhysOrg, ScienceToday, InnovationsReport and Concrete Products.

The structure was subjected to three months of rigorous shaking including earthquakes as powerful as magnitude 8.0. The structure survived 15 major earthquake ground motions, demonstrating the efficacy of the design methodology.

The test structure had over 600 channels of data acquisition including accelerometers, strain gages, displacement transducers and GPS. The data will be used in direct comparison to analytical predictions to validate the UA computer models. Once validated, extensive parametric analyses will be performed at UA in the upcoming year to calibrate design factors for the emerging design methodology, including appropriate design force levels and the expected deformation demands in given earthquakes.

The results of the research are to be implemented into the US building codes within the next few years. The project relies heavily on an active 12-member industry task group composed of seismic design consultants, precast producers and code-writing experts to transfer the research into practice. As a first step, a white paper describing the design methodology was approved by the BSSC Provisions Update Committee in April 2008 for publication in Part 3 of the 2009 NEHRP Recommended Provisions for Seismic Design of New Buildings.



# Highlights from 2008

By Dr. Kevin Lansey , CEEM Head

Greetings from Tucson and the University of Arizona. As many of you are aware, I was appointed

head of our department this summer. Juan Valdes stepped down after serving in this position for 11 years. He leaves quite big shoes to fill. The Department and I are extremely grateful for the time he and his wife, Maria, committed to the UA and the leadership that he provided. Juan remains with the Department as a professor and is heading up the National Science Foundation supported Science and Technology Center based at the UA.

In spite of the current economic conditions, Civil Engineering remains an area of opportunity. We anticipate that new federal resources will be provided to our field to spur the economy and rebuild our infrastructure. Further, our field is integral to meeting several of the Grand Engineering Challenges outlined by the National Academy of Engineering; specifically restoring and improving urban infrastructure and providing access to

clean water. Thus, as a community, we can make significant contributions to changing our economy to one that makes tangible things rather than one based on making money by moving it from place to place.

Our department is dedicated to producing graduates who are capable of contributing as engineers upon graduation. Over my 18 years at the UA, I have been impressed by the unique combination of technical skills and communication and leadership abilities that many of our students possess. Many firms recognize these skills and regularly come to the Department to recruit our engineers. I am proud to play a role in educating our students and venture that the faculty and staff add something of significance to them through our educational program. I hope that as graduates and employers you also recognize the value provided and the quality of UA Civil Engineering graduates.

In the coming months, Arizona will face dire economic conditions that will almost certainly dramatically affect the University budget. Your faculty and staff will be working hard to maintain the quality of

our program. Our alumni and friends are already outstanding contributors through teaching courses and guiding students through internships. For example, this fall, a group of alums organized and taught a LRFD bridge design class for our seniors and graduate students. We are extremely pleased to have this type of support and will likely be coming to you for advice and resources as we proceed.

I outlined three goals for the department during my interview: maintain the excellence of our undergraduate program, increase our research activity and expand our graduate program, and improve our relationships with our constituent groups. As part of the third goal, I had hoped that I would come to you under better conditions but am convinced that, working together, our faculty, staff, students, alumni and friends will succeed to achieve the first two goals in these challenging times.

Respectfully yours,  
Kevin



THE UNIVERSITY OF ARIZONA.

**Save the Date!**

2009

**Homecoming and Centennial Celebration**

Nov. 6 - Luncheon and Lecture  
Nov. 7 - BBQ and UA vs. WSU

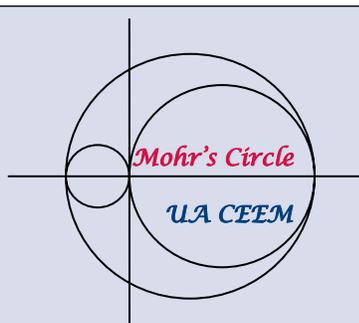
## NOMINATE AN ALUMNI FOR A CENTENNIAL AWARD

As part of Centennial Celebration, three awards were developed:

- Distinguished Alumni
- Centennial Professor
- Outstanding Young Alumni

These awards will be given at the Centennial luncheon next fall.

See <http://civil.web.arizona.edu/cms/> for award and nomination details.



**To support Departmental activities consider joining or urge your firm to join the Mohr's Circle**

**See the CEEM website for benefits**

## Researching Rillito River Sediment Transport

**USDA Research Agreement:** Professor Jennifer G. Duan recently developed a special cooperative agreement with USDA-Agricultural Research Service (ARS), Arid Land Agricultural Research Center (ALARC). The goal of the research is develop and implement physically based algorithms and computer code, merged with WinSRFR – the ARS/ALARC surface-irrigation software – to enhance the latter’s furrow-flow simulation capabilities to include prediction of sediment entrainment, deposition, and off-site discharge in the tailwater. The approach in this joint research effort is to share ARS and UA treatments of one-dimensional simulations of erosion, transport, and deposition of sediments in open channel flow. Both parties have been engaged for years modeling sediment transport in open channels, the UA concentrating on rivers and ALARC on irrigation furrows. The envisaged collaboration will broaden the scope of the UA modeling effort to include the very different boundary conditions of furrow flow – e.g., stream advance on a dry bed, flow with decreasing discharge – and lead to a greater understanding of erosion phenomena in general. ARS/ALARC will benefit from the insights already gained by the UA and speed development of a critically needed predictive erosion model to allow NRCS and other agencies to make irrigation recommendations that take sediment load into account.

**Technical Report News:** Prof. Jennifer Duan and her students have completed a study for the Pima County Regional Flood District to recommend a suitable flow and sediment



Irrigation Furrows

transport model for ephemeral rivers in the arid and semi-arid region. The final technical report entitled “Evaluation of Flow and Sediment Models for the Rillito River” is available online at CE website at [www.ce.arizona.edu](http://www.ce.arizona.edu).

## UA Gets NSF Career Grant to Study Non-uniform Sediment Transport



Jennifer Daun

**U**nder its prestigious Career program, which supports junior faculty who exemplify the teacher-scholar paradigm, the National Science Foundation has awarded a 5-year grant of \$415,560 to Assistant Professor Jennifer Duan. Dr. Duan’s proposal—Integrated Experimental and Numerical Modeling Study of Non-

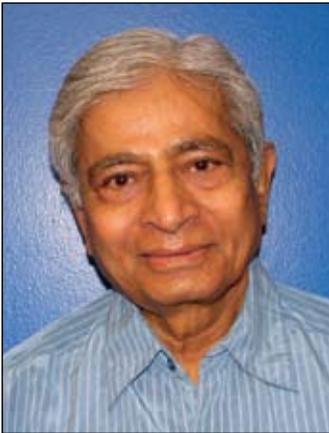
uniform Sediment Transport in Meandering Channels—reflects that no theory currently encompasses the complex interactions between flow, sediment transport, and fluid dynamics in meandering channels. Many numerical models applied to curved and meandering channels are based on experimental data acquired from studies conducted on straight laboratory flumes but never tested on sinuous channels.

Results from Duan’s lab-based experiments conducted on meandering channels will be integrated into a computerized model to simulate the processes of meandering migrations both in experimental flumes and in natural rivers. These results will enhance scientific understanding of river meanders and provide valuable guidance for river restoration.

The grant will fund a new experimental facility and computer model. The project will engage undergraduates in research, establish a mentoring program for women students, develop a computer animation exhibition for science museums, and support outreach to high school students. It will also stress computing in engineering teaching, increase visibility of women in engineering, and attract talented high school graduates to civil engineering.

# Awards and Recognition

## Engineering Mechanics Faculty Receive Awards



**Chandra S. Desai**

Dr. Chandrakant S. Desai, Regents' Professor, is the recipient of two international awards:

Diamond Jubilee Honour/Award by the Indian Geotechnical Society for significant contributions in research and professional practice. The award was presented to Dr. Desai during the inaugural function of Indian Geotechnical Conference (IGC-2008) at the Indian Institute of Science, Bangalore, India on 17th December, 2008.

Suklje Award/Lecture by the Slovenian Geotechnical Association, Slovenia for outstanding research and professional contributions. As a part of the award, Dr. Desai will travel to Slovenia during

September, 2009 at the time of the anniversary of Prof. Suklje, who was internationally prominent researcher and practitioner in the areas of Geotechnical Engineering and Geomechanics.

On behalf of Sage Publications, its Associate Editors and Executive Editors, Dr. Tribikram Kundu received the 2008 Structural Health Monitoring Person of the Year Award for his accomplishments and contributions to this field.

Congratulations  
Dr. Kundu on your  
prestigious award!



**Tribikram Kundu**

## Scholarships

### Arizona Society of Civil Engineers (AZSCE)

Brandon M. Gaumont  
Andrew Shroads  
Renee E. Riegert

### Harold Ashton

Ena Buzimkic  
John Fleming

### August V. Hardt

Britney S. Taylor

### Beavers Heavy Construction

Hunter McAnally

### Dr. Russell D. Whitenack

Taliehossadat Hajzargarbashi

### G & M Fremming Memorial

Alan A. Horton  
John-jozef Proczka

### Fred & Anastasia Glendening

Bruce Bell  
John Fleming  
James Jeffrey  
Ronald Thevenot  
Lauren Maine  
Corum K. Brown  
Daniel L. Cheslic  
Brandon M. Gaumont  
Colby Harris  
Anthony Heim  
Alan A. Horton  
Mark Murphy  
John-jozef Proczka  
Malorie Teich  
Kyana Young

### David J & Micki Hall

Samantha Jones  
Curtis Miles  
Sonia Sarmiento

### Jimenez RA Highway

Brenda Bustillos

### Mike Kolling Memorial

Vahab Toufigh

### Delbert R. Lewis Undergraduate

Andrew Shroads  
Alicia Mullenbach  
Matthew Schmidgal

### Delbert R. Lewis Graduate

Saeed Ahmari  
Samik Das  
Yessenia Garcia  
Radha K.C.  
Doo Sun Kang  
Jason Ruhl  
Vahid Toufigh  
Spencer S. Tucker  
Shiyan Zhang

### Quentin Mees

Brandon M. Gaumont  
Lily Gharib  
Sebastian Montenegro  
Renee E. Riegert

### J. Mellen

Andrew Alderink  
Amy Lynn  
Teri Marsh

### Carl & Jean Meng

Miguel R. Gaytan

### Elbridge & Genevieve Morrill Mem.

Irma Sofia Hernandez  
Vahab Toufigh

### Philip B. Newlin

Miguel Rafael Gaytan

### Paul G. Osborn Memorial

Alan A. Horton

### William Price

Sang Gu Lee

### Jane Rider

Anu Acharya  
Yessenia Isabel Garcia  
Taliehossadat Hajzargarbashi  
Megan D. Stull  
Kristen M. Ward

### Thomas L. Rittenhouse

Nicholas A. Cristi

### Paul T. Robinson

Ena Buzimkic  
Amy Lynn

### Rukkila Endow Eng.

Daniel L. Cheslic

### J Ruthrauff

Andrew Alderink  
Lauren Case

### Schramm

Vincent C. Steiner

### Schuff Steel

Michael J. Mielke  
Megan D. Stull

### S.&R.E. Shepherd

Vahab Toufigh

### John Sundt Memorial

Victor Liou  
Sebastian Montenegro  
David Silvertooth

### Glenn A. Wildman

Carlos Escarcega  
Jason Ruhl

### Wood, Patel & Associates

Renee E. Riegert

## EWB-UA Mafi Zongo Water Project Nears Completion



**E**ngineers Without Borders at the University of Arizona (EWB-UA) is a student chapter of a non-profit organization for engineers interested in making a difference in developing communities throughout the world. Founded in 2000, EWB is an internationally-recognized humanitarian organization that operates by having professional and student chapters partner with developing communities to implement environmentally, socially and economically sustainable engineering projects.

In 1995, 30 communities (pop. 10,000) in Ghana's Volta Region organized around the desire for improved water quality and accessibility. With the aid of a local nonprofit, the design and construction of a water system was completed in May 2005.

After experiencing difficulties, the community appealed to EWB for technical assistance. Having completed an initial assessment of the water system, the University of Arizona Chapter of EWB has just completed the design of an improved water filtration process and is currently planning its next trip to Ghana. The purpose of this visit is to complete the construction of the reinforced-concrete structure and begin the delivery of safe water to the villagers.

Since construction of the water purification and distribution system, various problems have plagued every aspect of the project. EWB-UA's assistance is required to address the failing earthen dam, slow filtration rates, inadequate drainage at the treatment facility, and leaking subsurface

pipes. As a result, communities have been forced to drink unsafe water compromising their health and livelihood.

The EWB-UA team completed its first visit in January 2006. The team conducted a health assessment to determine the overall condition of the villagers as well as identify the water-related illnesses that plagued community members. The team also completed site surveying to determine the capacity of the watershed area, dimensioned the existing treatment system and tested the water quality.

Surveying efforts confirm the watershed can accommodate the annual needs of all 30 villages. EWB-UA dimensioned existing structures to assist redesign efforts. Water quality analysis pinpointed the need for additional filtration.

A second assessment trip was completed in August 2006. The team taught local villagers how to properly



**Due to problems with the treatment process, water is delivered only every third or fourth day. As a result, villagers line up buckets to await the next water delivery.**

install and repair PVC pipes, completed surveying around the treatment facility to solve drainage issues, waterproofed the system's water tank and assessed damage to the earthen dam and spillway. The team continued to analyze the water quality and donated a digital turbidity meter to the community. Samples of sand from the slow sand filter were collected to troubleshoot slow filtration rates.

EWB-UA has designed a new pretreatment system to ensure the delivery of clean, safe drinking water to 10,000 people. The team needs your help to cover the cost of construction and travel. To date, almost 80% of the project's total cost of \$100,000 has been raised. However, the remaining funds are necessary in order to fund travel to the project site to oversee construction and start-up.



**Professional group mentor Scott Beeson CH2mHill stands with village children at one of the 21 standpipes**



**EWB-UA team members tour the water project with local community organizers**

# Alumni Update

## Robin G. West, P.E.R.L.S.



**Robin West**

working for several local firms before starting with the City of Tucson Transportation Department in 1982.

After three years in design engineering,

A 1976 Graduate of the UA Department of Civil Engineering and Engineering Mechanics, Robin worked for a short time for Chicago Bridge and Iron before returning to Tucson and

Robin was promoted to the Section Head of Development Review and served in this capacity for 12 years. During this time she helped create the City Development Standards, including the ADA details, the WASH ordinance and the Xeriscape Landscape standards.

Then she began her project management experience at the Tucson Pima Public library where she coordinated the site design for the George Miller Golf Links Library while rebuilding two older Library branches.

When she returned to the Transportation Department she worked on numerous

neighborhood Improvement projects including street lighting, sidewalks, landscaping, two neighborhood parks and one pedestrian overpass.

During the last three years, she moved to the technology services section of Transportation Department and processed the application and obtained funding release for a \$3.5 Million FHWA earmark grant to promote regionalization of the existing Transportation Data Network infrastructure.

During her retirement, she plans to travel, enjoy life and continue to support CEEM.

## Sumer Family

Derya and Ali, both PhDs from CEEM, moved to Sacramento, CA. Ali is an associate engineer at Buehler and Buehler Structural Engineers, where he designs schools and hospitals as well as residential buildings. He specializes in performance based seismic design. He received his California Professional Engineer license in 2007. Derya has been with CH2M HILL since February 2006. She has been a part of the water resources

modeling group in Sacramento office where she developed and applied water resources management models of California's Central Valley for clients such as California Department of Water Resources and US Bureau of Reclamation.

The Sumer family welcomed their first baby in January 2007. Their son, Deniz Erdem, is almost 2 years old now and counting down the days to become a UA student.



**Sumer Family**



Peru, South America - Peru LNG plant under construction & showing UA pride (October 2008).

## Juan Lopez

Juan Lopez, a 2005 B.S. and 2007 M.S. graduate, works in the Oil and Gas sector of Golder Associates, Inc. With Golder he has had the opportunity to work on several projects around the world. He has been involved in Liquefied Natural Gas (LNG) plant projects in Africa and South America. Currently, he is working on the construction of a marine trestle that is part of an LNG plant in Peru (see photo on left).

## Practitioner Led Bridge Design Course

Bridge design began a transition from Allowable Stress Design (ASD) based to Load and Resistance Factor Design (LRFD). This transition continues today. The major difference between the ASD and LRFD approaches is the way in which uncertainty in the loads and resistance is accounted for. Recognizing that students should be prepared for this new methodology, a group of practitioners approached CEEM in the fall of 2007 and offered to teach an introductory course on the topic of LRFD as applied to bridge design. They volunteered their services without charge. Seven professional engineers covering four areas of expertise met throughout the winter of 2007 and, joined by Prof. Mo Ehsani, the spring and summer of 2008 to organize the course content. From this effort, a senior-level/graduate-level course titled "Integrated Bridge Design Using LRFD Methodology" was offered in the fall 2008 semester to 24 students. To accommodate practitioner and student schedules, 3 hour classes were held on Saturday mornings. The course dealt with the various aspects of bridge design and its presentation required coordination among the four technical areas. For example, complementary introductory materials were developed including ones on LRFD methodology in specific areas. This volunteer



**Bridge design faculty and practitioners from left to right: Dave Zaleski, Ed Nowatzki, Naresh Samtani, Mo Ehsani, Brooks Keenan, and Tom McGovern.**  
**Not pictured: Scott Larson and Alejandro Angel.**

effort was a significant contribution to our students and program and is greatly appreciated. An expanded article on the course will appear in the next Civil View.

### Write to Us!

If you have an interesting event that you want to share with former classmates and friends, please send a letter with an update on your activities to:

Attn: Editor  
"Arizona Civil View"  
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Tucson, AZ 85721-0072

Or e-mail: [ceem@enr.arizona.edu](mailto:ceem@enr.arizona.edu)

Please include your name, degree (B.S., M.S., Ph.D.), year of graduation, address, home and/or business phone number, e-mail, and your current employment information. Thanks!