

Connections

Department of Civil and Environmental Engineering

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Hot Steel and Cold Logic: Studying the Effects of Heat-Straightening

Hot steel is a term with special meaning to Professor Amit Varma and graduate research assistant, Keith Kowalkowski. Using the capabilities of the new Civil Infrastructure Laboratory, these two CEE researchers are studying the process of heat-straightening of damaged steel.

Heat-straightening represents an increasingly popular technique for *in situ* repair of damaged steel, such as in bridge girders or beams that may have been damaged by an overheight truck. While this technique has proved efficient and economical, little is known about how repeated applications of the technique may affect the structural properties and microstructure of the steel. There are three goals for this research project

- Review the current *MDOT* heat straightening procedures and conduct a survey of heat-straightening procedures and guidelines used by other state departments of transportation.
- Investigate experimentally the effects of multiple heat-straightening on the *structural properties*, namely, the yield stress, ultimate stress, strain ductility, modulus of elasticity, notch toughness, and surface hardness, and the *microstructure* of steel.

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Dr. Amit Varma explains the laboratory setup for small-scale tests on the effects of heat-straightening.



This bridge on Michigan 127 shows a damaged girder that was later repaired by heat-straightening.



Keith Kowalkowski, graduate research assistant, applies heat to a damaged specimen of steel, one of 90 such specimens that he will test.

Continued from page 1.

- Develop simple recommendations and guidelines for evaluating and replacing steel members subjected to *multiple* damage/heat-straightening repair events.

This project can be very beneficial to state DOTs across the nation. The research itself is carried out in two phases: 1) small-scale tests on 90 samples of structural steel; 2) full-scale tests on actual damaged bridge beams. In the small-scale tests, samples of different types of structural steel are damaged in tension to a specified value. The specimen is then repaired by subjecting it to a compressive restraining stress and applying heat from an oxy-acetylene torch. Multiple damage/repair cycles are conducted on each specimen. The small-scale tests will be completed by late summer of 2003.

The conclusions from these small-scale tests will then be validated through three full-scale tests to investigate the effects of multiple damage/heat-straightening events on actual damaged bridge beams.

This project is funded by the Michigan Department of Transportation (MDOT, program manager Roger Till B.S. '76, M.S. '84). The project also receives technical expertise and guidance from the National Bridge Company, particularly Dan Garijo (B.S. '96) who has shared practical knowledge regarding the field use of heat-straightening. Other contributions came from Professor K.N. Subramanian (Chemical Engineering & Material Science) and the facilities of the CHEMS labs. For further information on this project, contact Amit Varma at ahvarma@egr.msu.edu.

Improving Concrete Pipes and Wastewater Infrastructure

This country's overall investment in wastewater infrastructure amounts to several *trillions* of dollars. As a critical part of that infrastructure, concrete pipes represent nearly \$3 billion in annual sales. Researchers within MSU's Department of Civil & Environmental Engineering have begun a long-term study aimed at developing and commercializing a new generation of concrete-based wastewater infrastructure systems. These new systems will exhibit substantially enhanced longevity, improved structural and hydrological performance, and greater initial and life cycle economy. Under a grant from the Environmental Protection Agency, Phase I of this research has already achieved promising results.

The research team employed a multi-faceted approach to enhance the resistance of concrete pipes to microbial-induced corrosion. Key elements of this approach included the following: (1) tailoring the chemistry of cement hydration products for enhanced acid resistance; (2) mitigating transport of aggressive solutions into concrete by making capillary pore surfaces hydrophobic and/or sealing capillary pores using polymer emulsions; and (3) making the concrete environment unsuitable for microbial growth.

CEE researchers have explored development of structurally efficient and streamlined concrete pipe designs through reinforcing concrete with high-modulus fibers at viable volume fractions. Judicious use of discrete fibers yields major improvements in flexural and shear strength, toughness and impact resistance of concrete. These improvements can be used to lower the steel reinforcement ratio of concrete pipes, increase the thickness of concrete cover over steel reinforcement, eliminate the need to enlarge the bell segment of pipes, and reduce the concrete pipe thickness and weight.

The CEE research team consists of members from the department's civil infrastructure and environmental engineering groups: professors Parviz Soroushian, P.E., Siavosh Ravanbakhsh, Xianda Zhao, and Syed Hashsham. For more information on the progress of this project, contact Dr. Soroushian at soroushi@egr.msu.edu.

Department News

Professor **Shu-Guang Li** received a prestigious award for his courseware *Interactive Groundwater*. It was named Premier Courseware of 2002. This award is given by the National Engineering Education Delivery Systems (NEEDS) Project, which is co-sponsored by John Wiley & Sons, Autodesk, MathWorks and Microsoft Research. Dr. **Amit H. Varma** received the American Institute of Steel Construction (AISC) Faculty Fellowship Award for 2003. This award provides a four-year grant for conducting research leading to the development of new and innovative long-span floor systems for multistory buildings.

Professor Emeritus Dr. **William E. Saul** was named as the recipient of the 2003 Steinman Award, given by the Michigan Society of Professional Engineers (MPSE). Dr. Saul was also named as a Fellow of the National Society of Professional Engineers (NSPE). Professors **Neeraj Buch** and **Karim Chatti** received the first place award in the curriculum category in the International Contest on LTPP Data Analysis. This contest is co-sponsored by the American Society of Civil Engineers (ASCE) and the Federal Highway Administration. The winning paper was titled "The Use of the LTPP Database in the Pavement Engineering Curriculum at Michigan State University."

Professor **Rigoberto Burgueño** and research assistant **Jun Wu** received one of two prizes awarded for the "outstanding paper by a young author" given by the International Association for Bridge and Structural Engineering (IABSE) at its symposium in Melbourne, Australia in September of 2002. The winning paper was titled "Development of an FRP Membrane Bridge System." Dr. **Burgueño** has also received a Daniel P. Jenny Research Fellowship from the Precast/Prestressed Concrete Institute (PCI). The PCI Research Fellowship program supports civil engineering graduate students in research related to precast and prestressed concrete.

With researchers at MSU's Center for Microbial Ecology, Dr. **Syed Hashsham** was a co-author of a paper, "Microbial Dehalorespiration with 1,1,1-Trichloroethane" that appeared in the November, 2002 issue of *Science*. The paper reports isolation of an anaerobic bacterium (TCA1) that derives its energy by degrading TCA (1,1,1-trichloroethane).

Russia Program Still Strong

The CEE study abroad program to Russia departed on May 20, 2003, with a return at the end of June. In spite of SARS and the war in Iraq, enrollment increased from 42 last year to 49 this year. However, the process for obtaining passports, letters of invitation and visas has become much more difficult in the current state of world events. Look for a feature on this program in the next issue of *Currents*.

Student News

Julie Galambos received the Outstanding CEE Senior SWE Award. The following students received an Academic Achievement Award: **Andrew Brinks**, **Timothy Greenleaf**, **Anthony Ingle**, **Daniel Kehoe**, **Katie Kidder**, **Justin Kuk**, **Benjamin Mattson**, **Jason Shingledecker**, and **Samuel Stafford**. **Andrew Brinks** also won an MSU Trustees Award. **Brian Nunes** won the Francis X. McKelvey Award for Transportation. **Seth Maher** won the award as Outstanding ENE Graduate Student. The award for Outstanding CE Graduate Student went to **Tunwin Savisdant**. The 2002-2003 **Steel Bridge Regional Competition** was held April 5, 2003, at Lawrence Technological University in Southfield, Michigan. Michigan State University finished third overall with a first place award in the stiffness category.



The 2002-2003 Michigan State University Steel Bridge Team. From Left to Right: Greg Heim, Kyle Phinney, Fan-Chuen Cheng, Carl Fedders (Captain), Jason Faigle (Captain), Michael Keenan, Brian Smith, Chris Derosia, Laura Wojcicki. Not Pictured: Mark Koskinen, Daryl Ross, John Hart, Alan Ostrowski, Tom West, Joseph Rodea, Dr. Frank Hatfield (Advisor), Dr. Amit Varma (Advisor).

A Heartfelt “Thank You” to Contributors for Supporting the CEE Department

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Special Recognition

The College of Engineering and the Department of Civil & Environmental Engineering join in thanking the following alumni and friends who have taken a leadership role through major gifts and pledges:

Mackenzie & Elaine Davis
Jerry N. McCowan
Ted & Cynthia Wynant

Mackenzie L. Davis Student Activity Discretionary Endowment Fund Established to Support Undergraduate Activities

Throughout his career at MSU, Professor Mack Davis devoted enormous time and energy to support undergraduate student activities, including the ASCE Concrete Canoe Team and the Environmental Engineering Student Society (EESS). Upon his retirement, Mack established the *Mackenzie L. Davis Student Activity Discretionary Endowment Fund*. The purpose of this fund is to ensure that future generations of CEE undergraduates can experience these activities. You can help support this endeavor and honor Professor Mack Davis at the same time.

For more information, please contact Jonathan Hill, associate director of development, College of Engineering, at (517) 355-8339.

Message from the Chairperson



This year I am especially proud of the national recognition that several of our faculty gained for their research and teaching. These and other significant achievements are posted regularly in the "Current Events and News" section of our Web page.

As this year closes, another faculty member dear to the hearts of our students and alumni is retiring. Professor Mack Davis has been with the department for 30 years, teaching more than 8000 students in over 200 sections of classes, and establishing a reputation as an outstanding teacher. He has received teaching awards at the national, regional and university levels. Mack has been faculty advisor to virtually every CEE student organization. Students and alumni love him not only for his outstanding teaching, but also for the camaraderie they enjoyed with him.

Throughout his career, Mack has been known for his generosity. But upon his retirement, he has crowned this generosity with a gesture that will live forever. He provided a large initial gift toward the creation of an endowment in support of student activities. I hope you will honor Mack and contribute to this fund and check the box on the last page to designate your gift.

Last year, the department and its Professional Advisory Board, created a Distinguished Alumni Award, given each year to an alumnus or alumna who has demonstrated outstanding leadership, support for the department, college or university, and community service. I invite you to nominate individuals for next year's award before September 1st of this year. The winner is selected by the department's Professional Advisory Board. Congratulations to Professor Emeritus Leo Nothstine (B.S. '38),

who received this year's award at the Annual Alumni Dinner on May 10th. Leo received an M.S. degree from Kansas State in 1940 and later joined our faculty. He is remembered fondly by many of our alumni. When he retired, Leo established an endowment to support fellowships for graduate students in structural engineering. He also is a strong contributor to the Civil Infrastructure Laboratory completed last year.

Let me close by thanking all of the alumni and friends who support the department and assist us in achieving our dreams.

Announcing the Jerry N. McCowan Endowed Scholarship/Fellowship in Civil & Environmental Engineering

Since 1993, Jerry N. McCowan has supported undergraduate students pursuing a degree in Civil & Environmental Engineering. In 2002, Mr. McCowan expanded the scope of the program by including support for graduate fellowships. Such support has become both a need and a priority within the department.

Alumni News

Kunwan Rajendra, P.E. (M.S. '72, Ph.D. '80) was recently elected as a Fellow of ASCE, quite an honor since fellows represent just over 6 percent of ASCE members.

Akira Yamaguchi (M.S. '75) is a bridge designer in Japan. He reports a poor demand for infrastructure work there right now and is hoping for better news. He proudly reports that he still exchanges letters with his landlady in East Lansing.

E-mail: apex-top@nifty.com

Joseph Gluck (B.S. '88) is director of operations for CBN Steel. CBN performs steel design/build projects and renovation projects for both the commercial and industrial markets. Joseph has managed projects in Canada, Mexico and across the United States. He is married to Rachel (B.S.N. '88), and they have three sons. He says "My years at MSU were some of the best and I credit MSU for giving me the opportunity to have the success I've had." *E-mail: Joe@CBNSteel.com*

Taegon Kim (Ph.D. '89) is a professor in the Division of Civil and Environmental System Engineering in the College of Engineering at Korea Maritime University and also participates in various engineering committees of the city of Pusan. *E-mail: taegonk@borahome.net*

Lizette Chevalier (M.S. '90, Ph.D. '94) is now chairperson of the Department of Civil Engineering at Southern Illinois University, Carbondale. *E-mail: cheval@enr.siu.edu*

Thomas Hruby, Jr., P.E. (B.S. '91) is vice president of North Texas operations for PSI and is responsible about \$6 million in fees. PSI services include environmental, geotechnical and construction materials engineering and testing.

Bob Overby (B.S. '95, M.S. '96) has worked with Reynolds, Smith and Hills, Inc. (RS&H) for five and a half years as an airfield engineer. Recent projects have included airfield improvements at major airports throughout Florida.

E-mail: bob.overby@rsandb.com

Khaled Al-Sahili (Ph.D. '95) is the director of the Construction and Transportation Research Center and an assistant professor at An-Najah National University. He is married with three boys and misses the good old days at MSU and the Spartan football and basketball teams.

E-mail: alsahili@yahoo.com

Sid Lockhart, P.E. (B.S. '97) is a project engineer for the Oakland County Drain Commissioner's Office. Sid manages water, sewer & storm drain construction projects for the county, and he also holds a master plumber's license. *E-mail: lockharts@co.oakland.mi.us*

Events Calendar

The MSU CEE department will hold a tailgate for alumni preceding the football game with Iowa on Saturday, September 27, 2003. The tailgate will be in the parking lot west of the Engineering Building. Look for the CEE banner!

Amy Berris (Garner) P.E. (M.S. '98) was hired as a project engineer at General Motors after being on contract at Ford since September 1998. Amy currently works in on-board diagnostics calibration. She previously worked in catalyst research and alternative fuels (ethanol and natural gas) engine calibration at Ford. Amy gave birth to a daughter, Adriane Sophia, on July 18, 2002. *E-mail: amy.berris@alumni.usc.edu*

Marcus Navetta (B.S. '99) works for Reynolds, Smith, and Hills, Inc. (RS&H), an A&E firm based in Jacksonville, Florida, where he is a project engineer in the aviation department. He has worked on a number of airports around the nation, designing everything from ground access systems to runways. *E-mail: marc.navetta@rsandb.com*

Hyesoon Kim-Yang (Ph.D. '02) is a senior engineer with Samsung Electronics in Korea. *E-mail: hskyang@samsung.co.kr*

First CEE Distinguished Alumni Award Goes to Leo V. Nothstine



On May 10, 2003, the Department of Civil and Environmental Engineering at Michigan State University presented its *Distinguished Alumni Award* to Professor Emeritus Leo V. Nothstine (B.S. '38). The award describes him as "Philanthropist, leader of the profession, teacher, mentor, colleague and friend to generations of engineers who honor him with respect and affection." Nominations for future awards should be submitted by 9/01/03 via the CEE Web site: www.egr.msu.edu/cee/alumni/alumniaward_form.doc

Graduate Student Research in the Civil Infrastructure Lab

Keith Kowalkowski

Keith graduated from MSU with a B.S. in Civil Engineering in 2002. His current graduate research is with Dr. Amit Varma and is sponsored by the Michigan Department of Transportation (MDOT). The project is titled “Effects of Multiple Heat Straightening on the Structural Properties of Steel” (see cover story). Heat-straightening is a cost-effective technique for *in situ* repair of steel bridges. Currently, little precise information exists to document the effect on steel of repeated applications of this technique. The goals of the research project include:



- Review the current MDOT heat straightening procedures and survey heat straightening procedures and guidelines used by other state departments of transportation.
- Investigate experimentally the effects of multiple heat-straightening events on the structural properties and the microstructure of steel.
- Develop simple recommendations and guidelines for evaluating and replacing steel members subjected to multiple damage/heat-straightening repairs.

Keith is conducting small-scale experimental tests that involve 90 specimens. These initial tests will lead to full-scale tests on actual beams. Keith notes that “The Civil Infrastructure Lab provides a large working environment for my test setup, including use of the 10-ton crane.”

Mario Quagliata

Mario also graduated from MSU with a B.S. in Civil Engineering in December 2001. He has focused his graduate study in structural engineering. For his research project, Mario works with Dr. Rigoberto Burgueño. The title of this project is “Biocomposite Beam/Panels for Load-Bearing Structural Components.”



The main goal in this research is to determine the feasibility of using biocomposite materials for load-bearing structural components in commercial and

residential buildings. The work involves assessing the current status of biocomposite materials, identifying structural systems and forms that make best use of the properties of biocomposites, and comparing the performance of biocomposite structures with conventional building material systems (such as concrete slabs and wood floors).

This project could lead to development of an environmentally friendly, bio-based, low-cost material that can compete with conventional fiber-reinforced plastics and/or wood products, which are taxing on the environment.

This research was carried out in collaboration with researchers from the Composite Materials and Structures Center (CMSC), including Dr. Amar Mohanty, Dr. Manjusri Misra, Dr. Lawrence T. Drzal, and doctoral student Geeta Mehta..

Sangdo (Victor) Hong

Victor came to MSU after receiving his B.S. in civil engineering from Lakehead University in Ontario, Canada. He is working with Dr. Ron Harichandran to study non-destructive evaluation techniques for structures retrofitted with carbon-fiber-reinforced-polymer (CFRP). The title of this project is “Sensors to monitor bond in concrete bridges rehabilitated with FRP.” CFRP is used as a composite material to retrofit or strengthen concrete structures. The bonding between the CFRP and concrete plays a crucial role in achieving composite action. Therefore, monitoring the integrity of the bond between the two materials is critical. The goal in this project is to develop a new, nondestructive evaluation technique using electrochemical impedance spectroscopy. Such a technique would be an improvement over other methods, which are often difficult to interpret and require skilled technicians and sophisticated data processing.



Victor notes the importance of the Civil Infrastructure Lab for his research. “My research includes tests with environmental effects. The new lab has a controlled environmental room, which allowed me to control and monitor such effects as humidity and temperature.”

How to Find Us

By mail:

Department of Civil and
Environmental Engineering
Michigan State University
East Lansing, MI 48824-1226

By e-mail: cee@egr.msu.edu

By phone: 517-355-5107

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