

## ENGINEERING JOURNAL

## Second Quarter 2018 Engineering Journal Now Available

The Second Quarter 2018 issue of AISC's *Engineering Journal* is now available. You can access the current issue as well as past issues at [www.aisc.org/ej](http://www.aisc.org/ej).

### ► Behavior of Deep, Wide-Flange Steel Beam-Column Members in Seismic Applications

*Frida Pettersson, Gian A. Rassati, James A. Swanson and Thomas M. Burns*

This study involves a parametric analytical investigation of the behavior of deep columns with one-sided reduced beam section (RBS) connections for application in special moment frames (SMFs). Earlier studies led to the prequalification of RBS moment connections for column sizes up to W14 sections. However, the use of deeper columns in SMFs would be advantageous because of their ability to economically control drift. Information on deep column behavior using an RBS moment connection is limited, and this study investigates this behavior using a total of 40 assemblies designed according to the 2016 AISC *Seismic Provisions*. Four column sections were investigated—W14×426, W24×192, W27×194 and W30×191—each subjected to five levels of axial load and two levels of panel zone strength, and modeled conservatively without floor slab restraint.

### ► Design Formulation for Critical Buckling Stress of Steel Columns Subjected to Nonuniform Fire Loads

*Mebrdad Memari and Hussam Mabmoud*

Assessing the stability of steel building frames exposed to fire conditions is challenging due to the need to consider elevated temperature properties of steel, nonuniform heating of structural members and large deformational demands on the frames. There has been significant progress recently in simulating the response of structural members and systems under fire loads using finite element methods. There is a need, however, for conducting additional analysis while expanding upon previous work to allow for the development of additional design

provisions for column buckling while accommodating varying temperature profiles. This study introduces a framework for conducting stability analyses of W-shape steel columns subjected to demands imposed by fire loads considering non-uniform longitudinal temperature profiles. Results from the analyses show good agreement with available strength design equations of steel columns at ambient and elevated temperatures.

### ► Experimental Evaluation of a Procedure for SMF Continuity Plate and Weld Design

*Adel Mashayekh and Chia-Ming Uang*

The AISC *Seismic Provisions* require continuity plates in an SMF welded moment connection to be connected to the column flanges by complete-joint-penetration groove welds. A design procedure has been proposed that allows the designer to evaluate the required forces in the continuity plates such that more economical welds (e.g., fillet welds) can be used; the required thickness of the continuity plates also need not be the same as that prescribed in the *Seismic Provisions*. With some minor modifications to the original design procedure, two one-sided reduced beam section moment connection specimens were designed and constructed for experimental verification of the proposed design procedure. To evaluate the effect of potential column kinking on the fillet-welded joints between the continuity plates and the column flanges, weaker panel zones were used that still satisfied the code requirement.

### ► Steel Structures Research Update: The Role of Gravity Framing in the Seismic Performance of Steel Buildings

*Judy Liu*

Ongoing work on the seismic performance of steel buildings is highlighted. The research fills knowledge gaps with respect to the role of gravity framing in the seismic response of steel buildings.

## People and Firms

- **Jonathan Humble**, FAIA, regional director of construction codes and standards for the American Iron and Steel Institute (AISI)—where he has worked for 22 years—has been named to the College of Fellows of the American Institute of Architects (AIA). Recipients of this designation are selected by the AIA's Jury of Fellows for their notable contributions to the advancement of the profession of architecture. Humble will be recognized in June at the investiture ceremony at St. Patrick's Cathedral during the 2018 AIA Conference on Architecture in New York City.



- **Jason McCormick**, PhD, is one of four University of Michigan professors to be named an Arthur F. Thurnau Professor, the highest honor the university bestows on a faculty member in direct recognition of their demonstrated impact on education. McCormick, an associate professor of civil and environmental engineering in the College of Engineering and AISC's 2010 Milek Fellow, co-pioneered a new approach to show civil and environmental engineering students how structural systems are designed and how they can fail. In his approach, students use virtual reality to visualize and interact with components from multiple angles in a 3D lab so they can "feel" how massive loads are carried down from structure to foundation.



## IN MEMORIAM

## Earthquake Engineering Expert Stephen Mahin Dies at 71

Stephen A. Mahin, a world-renowned expert in earthquake engineering, passed away on February 10.

Mahin was born in Lodi, Calif., on October 16, 1946. Upon graduating from high school, he spent more than five decades at the University of California (UC), Berkeley—first as a student and then as faculty. He received three civil engineering degrees at UC Berkeley—a BS (Honors), an MS and a PhD—served as an assistant research engineer from 1974 to 1977 and then joined the faculty as an assistant professor in 1977. Over his UC Berkeley career, he served as the chair of the Structural Engineering, Mechanics and Materials (SEMM) Program from 1990 to 1993 and was the director of PEER (Pacific Earthquake Engineering Research Center) from 2009 to 2015. Most recently, he was the school's Byron L. and Elvira E. Nishkian Professor Emeritus of Structural Engineering in the Department of Civil and Environmental Engineering.

Mahin published hundreds of journal articles, papers and reports, and the range of topics reflects the comprehensive and broad expanse of his research engagement. AISC honored him with its Special Educator Achievement Award in 2001 for leadership in improving steel structures subjected to earthquakes, and its Lifetime Achievement Award in 2013 for sustained contributions to the profession, industry and academia. He served as program manager for the six-year FEMA-sponsored SAC Steel Project, which developed guidelines for the design of steel moment frame structures following the 1994 Northridge earthquake. The SAC guidelines and supporting documents led directly to major changes to the AISC seismic design standards used in the U.S. and worldwide.

“Steve’s impacts on improving seismic design and the structural engineering profession went far beyond the SAC project, but this was certainly an important highlight of his and many of our careers,” said James O. Malley, SE, PE, group director and senior principal with Degenkolb Engineers in San Francisco. “He was a man of never-ending ideas and

energy, and one that was instrumental in supporting and fostering the careers of many, many people within our industry.”

In 2016, Mahin became the founding director of the Computational Modeling and Simulation Center (SimCenter) of the Natural Hazards Engineering Research Infrastructure, funded by the National Science Foundation. Under his leadership, the SimCenter assembled a talented multi-university team of researchers to advance simulation methods to reduce the effects of natural hazards on the built environment, with the ultimate goal of improving community resilience to earthquakes, storms and other extreme hazards.

“He gave his life’s work for the safety of society in severe earthquakes, and he certainly made important new discoveries,” said Ted Galambos, PhD, professor emeritus with the Department of Civil, Environmental and Geo-Engineering at the University of Minnesota. “He was indeed a great leader in his field.”

In 1983, Mahin was awarded the ASCE Walter Huber Civil Engineering Research Prize for his practical application of rigorous theory to complex engineering problems. In 1987, he was awarded the Norman Medal by ASCE for his seminal work on the seismic behavior of offshore platforms, and in 2012 he was inducted into the ASCE/OTC Hall of Fame. His pioneering work on self-centering bridges earned him the FHWA James Cooper Best Paper Award in 2007. He served as a director of the Structural Engineers Association of Northern California (SEAONC) and was awarded SEAONC’s Helmut Krawinkler Award in 2017 for outstanding leadership in implementing state-of-the-art research into structural engineering practice. In addition, he chaired the NEHRP Northridge Earthquake Engineering Research Coordination Program from 1995 to 1997.

“Steve was an impressive and generous force based on his deep understanding of the behavior of structures under seismic loads,” noted Tom Schlafly, AISC’s director of research. “His contributions to seismic design methods will have an impact on our *Seismic Provisions*

and designers for years to come due to his work on SAC, his many students and his prolific collaborations with leaders in the seismic engineering community. We are thrilled that we recently supported Steve’s work on strongback frames that we believe, as Steve did, will become a frequently used system.”

Mahin had a unique talent for interacting and making friends with fellow researchers throughout the world, and he was invited to give keynote addresses at several national and international conferences. Many international research collaborations with Asian countries were initiated and nurtured by his leadership. Over three decades, he enlightened, guided and led multiple phases of U.S.-Japan research collaboration on earthquake engineering using large-scale test facilities operated by the two countries. He chaired the NSF US-Japan Cooperative Earthquake Research Program on Composite and Hybrid Structures from 1995 to 1999 and the NEES/E-Defense Collaborative Research Program since 2004.

“We will miss this great man and wonderful person,” remarked Gregory MacRae, a professor in the department of Civil and Natural Resources Engineering at the University of Canterbury in Christchurch, New Zealand. “We say here [in New Zealand] that ‘a mighty Totara has fallen.’”



BRIDGES

## New Thermal Spray Coatings Guide Now Available

A new free guide specification by the AASHTO/NSBA Steel Bridge Collaboration, *Specification for Application of Thermal Spray Coating Systems to Steel Bridges* (S8.2), is now available. The document provides guidance on shop metallizing steel girders while establishing and defining the functions, operations, requirements and activities needed to achieve a consistent quality.

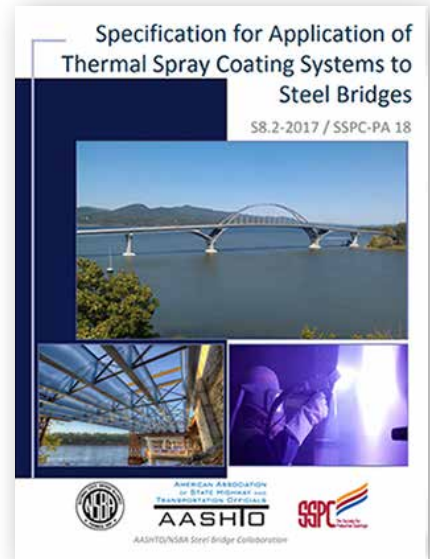
Over the past two years, the AASHTO/NSBA Collaboration task group on coatings (TG8) has been developing a specification for the application of thermal spray coating (metallizing). In 2017, AASHTO and SSPC officially adopted S8.2. A collaborative effort was taken in the development of the document to ensure owners' and applicators' representatives have clearly defined roles and responsibilities. While using thermal

spray coatings on steel structures is not new, the practice is new to steel bridges and has been growing in popularity with bridge owners, especially in the north-eastern U.S. At least four steel bridge fabricators now have in-house thermal spray application abilities. With growing interest and increasing fabricator capabilities, it was imperative a specification be developed to define a consistent set of standards. This document works to achieve that goal.

S8.2 is written in specification language so the document can be adopted in whole as part of the project contract documents. It joins a growing list of documents devoted to improving quality and value through the standardization of design, fabrication and erection of steel bridges.

This document and other guide specification documents from the Collaboration

are available at [www.steelbridges.org/collaborationstandards](http://www.steelbridges.org/collaborationstandards).



NASCC

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And if you are able to attend in person

(and haven't registered yet!) one low registration fee gains you access to all of the technical sessions, the keynote sessions, the T.R. Higgins Lecture and the exhibition hall. For more information and to register, visit [www.aisc.org/nascc](http://www.aisc.org/nascc).