# Structures Congress 2011



ASCE

Edited by Dana Ames, P.E. Theodore L. Droessler, P.E. Marc Hoit, Ph.D.



This is a preview. Click here to purchase the full publication.

# Structures Congress 2011

#### PROCEEDINGS OF THE 2011 STRUCTURES CONGRESS

April 14–16, 2011 Las Vegas, Nevada

SPONSORED BY
The Structural Engineering Institute (SEI)
of the American Society of Civil Engineers

EDITED BY
Dana Ames, P.E.
Theodore L. Droessler, P.E.
Marc Hoit, Ph.D.





**Published by the American Society of Civil Engineers** 

### **Copyright and Disclaimer**

ISBN: 978-0-7844-1171-1

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document.

ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefore. This information should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing this information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

Copyright © 2011 by the American Society of Civil Engineers. All Rights Reserved.

ASCE and American Society of Civil Engineers—Registered in U.S. Patent and Trademark Office.

American Society of Civil Engineers ASCE International Headquarters 1801 Alexander Bell Drive Reston, VA 20191-4400 USA

Call Toll-Free in the U.S.: 1-800-548-2723 (ASCE) Call from anywhere in the world: 1-703-295-6300

Internet: http://www.pubs.asce.org

### **Preface**

Preparation for the 2011 Structures Congress required significant time and effort from the members of the Local Planning Committee, the National Technical Program Committee, and the staff at SEI. Therefore, much of the success of the conference is a reflection of the level of effort by this group of volunteers.

The committee would like to acknowledge the critical support of the sponsors, exhibitors, presenters, and participants who contributed to the success of the conference through their participation.

The Structures Congress technical program consists of over 100 concurrent technical sessions on topics that are redefining structural engineering in the areas of bridge and transportation structures, buildings, strategies for today's global economy and advances in research. The CASE Spring Risk Management Convocation and the Forensic Specialty Track supplement the Congress. All of these help enforce networking, interacting and forming partnerships with our structural peers.

Sharing in the success of the 2011 Structures Congress are our cooperating organizations, CASE, SEAOC, SEASON, ACI, Las Vegas Chapter, ACEC Nevada, Southern Nevada Post Society of American Military Engineers, ASCE San Francisco Section, ASCE Los Angeles Section, ATC and ASCE Southern Nevada Branch.

On behalf of our dedicated volunteers and SEI staff, we would like to thank you for spending your valuable time attending the 2011 Structures Congress. It is our hope that you and your colleagues will benefit greatly from the information provided and make professional connections that lasts for years. By increasing communication skills, helping the practicing engineer expand his or her knowledge, leadership, and influence, we believe that delegates will learn how to excel in this new and exciting environment.

Dana Ames and Theodore L. Droessler Co-Chairman, Local Planning Committee

# Acknowledgments

#### **Local Planning Committee**

Dana Ames, P.E., S.E. Co-Chairman R2H Engineering, Inc Theodore L. Droessler, P.E. Co-Chairman Clark County Department of Development Services, Building Division Curt Haldeman, P.E. Granite Construction Company

Arvid Handegard, P.E. Jacobs Engineering

Chuck Joseph, P.E. Jacobs Engineering

Ron Lynn, C.B.O. Clark County Department of Development Services, Building Division

Daniel Paulis, P.E. CH2M HILL

Aly Said, Ph.D. University of Nevada, Las Vegas

Kaushal Shah, P.E., S.E. BergerABAM

Craig Smart, P.E. HDR

Ying Tian, Ph.D. University of Nevada, Las Vegas (UNLV)

# **Table of Contents**

## **Bridges**

Seismic Reliabilit	y and Performance A	<b>Assessment of Bridges</b>
--------------------	---------------------	------------------------------

System-Level Calibration of Bridge Component Damage States K. R. Mackie	
Seismic Fragility Estimates and Optimization of Retrofitting Strategies for Reinforced Concrete Bridges: Case Study of the Fabela Bridge in Toluca, Mexico V. Bisadi, M. Head, and P. Gardoni	13
Effect of Ground Motion Suite Size on Uncertainty Estimation in Seismic Bridge Fragility Modeling  B. G. Nielson and W. C. Pang	23
Reliability and Redundancy of Bridge Systems under Lateral Loads G. Anitori, J. R. Casas, and M. Ghosn	35
Long Term Structural Health Monitoring of Bridges	
Anomaly Detection without Structural Behavior Models  I. F. C. Smith	47
Damage Detection and Localization in Structures: A Statistics Based Algorithm Using a Densely Clustered Sensor Network Elizabeth L. Labuz, Shamim N. Pakzad, and Liang Cheng	53
Bridge Structural Health Monitoring Specification: 2020	
Monitoring of Long Term Bridge Performance (LTBP) Program Bridges  Steven M. Petroff, Marvin W. Halling, and Paul J. Barr	65
Data-Driven Methods for Threshold Determination in Time-Series Based Damage Detection Ruigen Yao and Shamim N. Pakzad	77
A Characterization of Traffic and Temperature Induced Strains Acquired Using a Bridge Monitoring System  Mustafa Gul, H. Burak Gokce, and F. Necati Catbas	89
Proposed Data Specifications for Bridge Structural Health Monitoring Sensor Data	101
Stephen Prusaczyk, Richard Christenson, John Dewolf, Alireza Jamilapour, and John Bar	toletti
Cable Supported Bridges	
Wind Engineering Studies for a Cable-Stayed Bridge in Talavera de la Reina, Spain	113

F. Nieto, S. Hernández, J. Á. Jurado, F. Pereira, and A. Díaz

Assessing and Retrofitting Steel Bridges for Fatigue		
Detection of Critical Fatigue Cracks in Steel Bridge Materials with Remote Acoustic Emission Monitoring Jianguo Yu and Paul Ziehl	123	
Improved Method for Bonding CFRP Overlays to Steel for Fatigue Repair Fatih Alemdar, Adolfo B. Matamoros, Caroline R. Bennett, Ron Barrett-Gonzalez, and ST. Rolfe	<b>133</b> Stanley	
Fatigue Repair of the Arkansas River Bridge Y. Zhao, K. W. M. Roddis, G. Ramirez, and J. P. Jones	145	
Experimental Investigation of Bridge Response		
Experimental Study of Shear Capacity of Reinforced Concrete Slabs  Eva Lantsoght, Cor van der Veen, and Joost Walraven	152	
Seismic Response of Bearings for Quasi-Isolated Bridges—Testing and Component Modeling	<b>164</b>	
J. S. Steelman, L. A. Fahnestock, J. M. LaFave, J. F. Hajjar, E. T. Filipov, and D. A. F		
Measurements of a Steel Orthotropic Deck under Crawl Loading S. Roy, R. S. D. Alapati, N. K. Manandhar, and J. W. Fisher	179	
Innovative Bridge Design and Construction Approaches		
Simplified Erection Guidelines for Double I-Girder Systems during Bridge Construction  Quihong Zhao, Baolin Yu, and Edwin G. Burdette	190	
Feasibility Analysis of Using UHPC in Prestressed Bridge Girders	203	
Christopher W. Taylor, Kristin F. Montoya, David W. Jáuregui, Craig M. Newtson, and Weldon		
Innovative Bridge Analysis Approaches		
Effect of Secondary Elements on Load Distribution in Prestressed Bridge Girders	215	
M. R. Roddenberry, J. Chipperfield, and K. S. Tawfiq		
Bridges Subjected to Impact Loads of Moving Vehicles Obtained from Vehicle Dynamics	227	
S. Jerath and S. B. Gurav		
Elastic Nonlinear Analysis of Plane Truss Bridges  Morteza A. M. Torkamani and Jyh-Hung Shieh	239	
Innovative Seismic Analysis of Bridges		
Seismic Analysis of Bridge Columns under Axial, Flexure, Shear, and Torsional Loadings  T. Ravi S. Mullapudi and Ashraf Ayoub	252	

Effect of Abutment Shear Keys on the Seismic Response of Bridges M. W. Salveson and B. V. Fell	265
Computational Analyses of Quasi-Isolated Bridges with Fusing Bearing Components	276
E. T. Filipov, J. F. Hajjar, J. S. Steelman, L. A. Fahnestock, J. M. LaFave, and D. A	. Foutch
Seismic Analysis of Integral Abutment Bridges Including Soil-Structure Interaction	289
Qiuhong Zhao, Reza Vasheghani-Farahani, and Edwin G. Burdette	
Buildings	
Long Span Stadium Roofs	
Erection of the Cable Net Roof for the London 2012 Olympic Stadium N. Cole and P. Hulme	304
Challenges of Retrofitting an Existing Domed Stadium with a New Retractable Roof—BC Place Stadium, Vancouver, BC  David M. Campbell and Karen A. Lynch	314
Design of the Retractable Roof for the Florida Marlins' New Ballpark Stephen E. Blumenbaum and Aaron C. White	324
Wind Induced Torsional Loads on Buildings	
Evaluation of Wind-Induced Torsional Loads on Buildings by North American and European Codes and Standards  M. Elsharawy, T. Stathopoulos, and K. Galal	337
Wind-Induced Torsional Loads on Low-Rise Buildings M. Elsharawy, K. Galal, and T. Stathopoulos	349
Floor Vibration Serviceability	
Floor Vibration Characteristics of Long Span Composite Slab Systems T. Andres Sanchez, Brad Davis, and Thomas M. Murray	360
Impedance Modeling for Prediction of Train Induced Floor Vibrations M. Sanayei, N. Zhao, P. Maurya, J. A. Moore, J. A. Zapfe, and E. M. Hines	371
Simplified Methods for Estimating the Response of Floors to a Footfall C. J. Middleton and J. M. W. Brownjohn	383
Efficient Design of Floor Structures Using Active Vibration Control M. J. Hudson, P. Reynolds, and D. Nyawako	404
Structural Performance in Fire	
A Comparison between the Single Plate and Angle Shear Connection Performance under Fire Serdar Selamet and Maria F. Garlock	416

Effects of Thermal Expansion and Support Restraints on Performance of Composite Floors in Fire  H. Mostafaei and F. Alfawakhiri	427
RC Bearing Walls Subjected to Elevated Temperatures M. J. McGinnis, K. A. Mueller, Y. C. Kurama, and K. P. Graham	439
Experimental Evaluation of Composite Floor Assemblies under Fire Loading Purushotham Pakala, Rustin Fike, Emily Wellman, Venkatesh Kodur, and Amit Varma	451
Behavior of Steel Columns under Fire Loading Lisa Choe, Amit H. Varma, and Andrea Surovek	463
Integrating Life Cycle and Carbon Assessments	
Carbon Emissions and Building Structure: What the Structural Engineer Needs to Know about Carbon in the 21st Century  Mark D. Webster, Helena Meryman, and Dirk M. Kestner	472
Life Cycle Assessment Using ATHENA Impact Estimator for Buildings: A Case Study  Elizabeth Stek, Dave DeLong, Terry McDonnell, and Jose Rodriguez	483
Integrating Life Cycle and Carbon Assessments: What Life Cycle Assessment Can Teach Structural Engineers about Design and Specification Frances Yang	495
Infrastructure Sustainability: Streamlining Life Cycle Assessment for Practicing Bridge Engineers  Jeralee L. Anderson	507
Tall Building Design in Seismic Regions: Design Philosophies and Global Perspectives	
Deflection Limits in Tall Buildings—Are They Useful? Rob Smith	515
Structural Analysis and Design Challenges of the Ping An Tower under Consideration of the Upcoming China Code	528
Dennis C. K. Poon, Ling-en Hsiao, Yi Zhu, Steven Pacitto, Steve Zuo, Torsten Gottle Shenming Wang	be, and
Non-Linear Time History Analysis for the Performance Based Design of Shanghai Tower  Dennis C. K. Poon, Ling-En Hsiao, Yi Zhu, Leonard Joseph, Steve Zuo, Guoyong Fu, a Ihtiyar	<b>541</b> and Onur
Reinforcing Topics for Concrete Structures	

**Effect of Stirrups on the Contribution of Concrete Compressive Strength and 552 Tensile Steel to the Shear Strength of RC Beams Using Artificial Neural Networks** Hassan El-Chabib

Cyclic Response of Concrete Frame Members Reinforced with Ultrahigh Strength Steel H. Tavallali, A. Lepage, J. Rautenberg, and S. Pujol	560
Nominal Shear Strength Limits for Short Diagonally-Reinforced Concrete Coupling Beams  Steven Barbachyn, Yahya C. Kurama, and Lawrence C. Novak	571
Existing Masonry Buildings Evaluation and Retrofit	
A Simple Method in the Preliminary Assessment of Historic Masonry Buildings James S. Cohen	583
Problems in the Repair of Historic Brick Masonry Buildings  James S. Cohen	594
Reliability Analysis of Masonry Members under Compression S. Kazemi, M. Mahoutian, H. Moosavi, and Y. Korany	605
Wood Light Frame Design	
Is Roof Eave Blocking Required to Transmit Wind/Seismic Forces?  Felix Martin	616
Truss Plates for Use As Wood-Concrete Composite Shear Connectors  Peggi L. Clouston and Alexander C. Schreyer	626
Effect of Support Restraint on Wood-to-Wood Joist Hanger Connection William T. Bolduc and Samaan Ladkany	636
Contextualizing the Load Duration-Dependent Strength of Wood Members G. R. Searer, T. F. Paret, and R. J. Kristie	650
The 14th Edition AISC Steel Construction Manual	
The AISC 2010 Specification and the 14th Edition Steel Construction Manual Larry Muir and Cynthia J. Duncan	661
Seismic Design of Cold Formed Steel and Metal Building Systems	
Development of Seismic Design Provisions for Steel Sheet Sheathed Shear Walls	676
C. A. Rogers, N. Balh, C. Ong-Tone, I. Shamim, and J. DaBreo	
Seismic Design of Diagonal Strap Bracing Using AISI S213  Greg Greenlee	688
Earthquake Simulator Testing of Metal Building Systems C. M. Uang, M. D. Smith, and W. L. Shoemaker	693
Seismic Force Distribution for Metal Building Systems with Mezzanines M. D. Smith and C. M. Uang	705