# **Structures Congress 2017**

## **Buildings and Special Structures**

Selected Papers from the Structures Congress 2017

Denver, Colorado, USA 6 – 8 April 2017

**Editor:** 

J. G. (Greg) Soules

ISBN: 978-1-5108-3944-1

#### Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2017) by American Society of Civil Engineers All rights reserved.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact American Society of Civil Engineers at the address below.

American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 USA

Phone: (800) 548-2723 Fax: (703) 295-6333

www.asce.org

#### Additional copies of this publication are available from:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 USA

Phone: 845-758-0400 Fax: 845-758-2633

Email: curran@proceedings.com Web: www.proceedings.com

### **Contents**

### Buildings

Nonlinear Dynamic Analysis of Multi-Sloshing Mode Tuned Liquid Sloshing Dampers Installed in Tall Buildings1
U. Y. Jeong
Eliminating the Exposure Category from Wind Design Pressure
Wind Load Prediction on Tall Buildings in a Stochastic Framework24 M. Gibbons, J. Galsworthy, M. Chatten, and S. Kala
Experimental Investigation of Deconstructable Steel-Concrete Shear Connections in Sustainable Composite Beams
Lizhong Wang, Mark D. Webster, and Jerome F. Hajjar
Influence of Fastener Spacing on the Slip Modulus between Cold Formed Steel and Wood Sheathing48
Weston Loehr, Bill Zhang, Hani Melhem, and Kimberly Krammer
BRBM Frames: An Improved Approach to Seismic-Resistant Design Using Buckling-Restrained Braces
Leo Panian, Nick Bucci, and Steven Tipping
Implications of Modeling Assumptions on the Loss Estimation for Shear Wall Buildings
Kristijan Kolozvari, Vesna Terzic, and Daniel Saldana
Numerical Investigation of the Shear Buckling and Post-Buckling of Thin Steel Plates with FRP Strengthening
Mohamad Alipour, Alireza Rahai, and Devin K. Harris
Seismic Evaluation of Incremental Seismic Retrofitting Techniques for Typical Peruvian Schools
Advanced Technical Issues Related to Wind Loading on Tall Building Structures in Consideration of Performance-Based Design

ASCE 41-17 Steel Column Modeling and Acceptance Criteria
Leveraging Cloud and Parametric Workflows to  Accelerate Performance Based Seismic Design
Stability of Steel Columns in Steel Concentrically Braced Frames  Subjected to Seismic Loading
Classifying Cyclic Buckling Modes of Steel Wide-Flange Columns under Cyclic Loading
Gulen Ozkula, John Harris, and Chia-Ming Uang
Structural Behaviour of Demountable HSS Semi-Rigid Composite  Joints with Precast Concrete Slabs
Topology and Sizing Optimization of Nonlinear Viscous Dampers for the Minimum-Cost Seismic Retrofitting of 3-D Frame Structures179 Nicolò Pollini, Oren Lavan, and Oded Amir
Structural Topology Optimization Considering Complexity
Cast Steel Replaceable Modular Links for Eccentrically Braced Frames202 J. Binder, M. Gray, C. Christopoulos, and C. de Oliveira
New Methods in Efficient Post-Tensioned Slab Design Using Topology
Optimization
Design and Parametric Finite Element Analysis—A Thin Lightweight Two-Way Steel Flooring System
Structural Form Finding of a Rope Sculpture
Discussion of Tubular Steel Monopole Base Connections: The Base Weld Toe Crack Phenomenon; Crack Identification and a Proposed Severity Classification System248 Brian R. Reese and David W. Hawkins

Building Structures
Mandy Chen and Lance Manuel
Effect of Damaged Fireproofing on the Behavior of Structural Steel
Members
Ataollah Taghipour Anvari, Mustafa Mahamid, and Michael J. McNallan
A Re-Evaluation of $f'_m$ —Unit Strength Method, Face Shell, and Fully Bedded Mortar Joints
N. Westin and M. Mahamid
Parametric Study and Design Procedure for Skewed Extended Shear Tab Connections
Mutaz Al Hijaj and Mustafa Mahamid
Scaffolding a Landmark: The Restoration of the Dome of the United States Capitol Building319
Christopher P. Pinto and Joelle K. Nelson
Achieving Column-Free Platforms—Design and Construction of Large Span Station Mezzanines on the Second Avenue Subway Project329 Renée Grigson and Michael Voorwinde
Evaluation of Full-Scale Adobe Brick Walls under Uniform Pressure343 S. Robert, H. El-Emam, A. Saucier, H. Salim, and Scott Bade
Experimental Study of Externally Flange Bonded CFRP for Retrofitting Beam-Column Joints with High Concrete Compressive Strength
Considerations in the Use of Side Load Pier Brackets365  James Robert Harris and Kenneth Cobb
Retrofitting of Flange Notched Wood I-Joists with Glass Fiber Reinforced Polymer (GFRP) Plates
M. Shahidul Islam and M. Shahria Alam
Multiple Hazards and Social Vulnerability for the Denver Region386 A. Rein Starrett and R. B. Corotis
A Top Down Approach to Achieve Full System Modeling in Seismic Analysis and Design

Experimental and Numerical Investigation of Flexural Concrete Wall  Design Details
A. Behrouzi, T. Welt, D. Lehman, L. Lowes, J. LaFave, and D. Kuchma
Seismic Response Study of Degraded Viscous Damping Systems for Tall Buildings in China
Topology Optimization and Performance-Based Design of Tall Buildings:  A Spatial Framework
Effects of Foundation Uplift on the Dynamic Response of Steel Frames459 Mohammad Salehi, Amir Hossein Jafarieh, and Mohammad Ali Ghannad
Performance-Based Wind and Seismic Engineering:  Benefits of Considering Multiple Hazards
Effect of Drift Loading History on the Collapse Capacity of Deep Steel Columns
Properties of and Applications with Full Locked Coil Rope Assemblies495 KJ. Thiem and M. Bechtold
U.S. Bank Stadium: Transparent Roof Steel Collaboration
Advanced Analysis of Steel-Frame Buildings for Full Story Fires515 Erica C. Fischer and Amit H. Varma
Integrated Fire-Structure Simulation Methodology for Predicting the Behavior of Structures in Realistic Fires
Structural Design, Approval, and Monitoring of a UBC Tall Wood Building
Adaptive Reuse of the Historical Ferdinand Building, Boston, MA548 John Looney
Fire Safety and Tall Timber Buildings—What's Next?556 David Barber

The New Tocumen International Airport South Terminal in Panama City, Panama570
Andrea Soligon, Jeng Neo, and Xiaonian Duan
Multi-Hazard Design of a New Emergency Communications Facility in St. Louis, Missouri
Nathan C. Gould, Richard Hoehne, and Michael Shea
Prison Design in Haiti: Structural Challenges
Underpinning Historic Structures at Grand Central Station, New York604 Yazdan Majdi and Richard Giffen
Design of an Underground Viaduct for the Expansion of the Moscone Center614
A. Trgovcich, L. Panian, and S. Tipping
Nonbuilding and Special Structures
Extreme Wave Monitoring and In Situ Wave Pressure Measurement for the Cofferdam Construction of the Pingtan Strait Bridge
What We Learned from the Cooling Tower Foundation Design Challenges from a Revamp Project
Design of Industrial Pipe Racks Using Modules, Pre-Assembled Units, and Stick-Built Construction
Ship Impact and Nonlinear Dynamic Collapse Analysis of a Single Well Observation Platform
Pile Cap Seismic Load Transfer to Soil
Constructability Solutions for Temporarily Supporting 200' Flare Stacks during Construction Modifications
Custom Helical Pile Use for a Refinery Revamp: A Case Study706 Eric Wey Patrick Murray Howard Perko Malone Mondoy and Paul Volne