

Forensic Engineering 2015

Performance of the Built Environment

Miami, Florida, USA
15 - 18 November 2015

Editors:

**Alicia E. Diaz de Leon
Clemens J. Rossell
Anthony M. Dolhon**

**Michael J. Drerup
Joshua B. Kardon
Michael P. Lester**

ISBN: 978-1-5108-2390-7

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© (2015) by American Society of Civil Engineers
All rights reserved.

Printed by Curran Associates, Inc. (2016)

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

Track A

ACI 562

ACI 562—The Concrete Repair Code	1
Keith Kesner	
Using ACI 562 as the Standard to Assess Damages in Existing Concrete Structures	10
Gene R. Stevens	
Structural Repair of a Concrete Parking Garage Structure Using ACI 562	20
Kevin Conroy and Gustavo Tumialan	
Load Testing Techniques for the Strength Evaluation of Existing Reinforced Concrete Structures	30
Mohamed ElBatanouny, Paul Ziehl, Carl (Chuck) Larosche, and Antonio Nanni	

Building Envelope Leakage

Air Leakage, Moisture Migration, and Condensation in a Building Enclosure.....	40
J. S. Der Ananian, S. M. O'Brien, and C. M. Saldanha	
Balcony View	51
Bart B. Barrett and David Cannon	
Adhered Masonry Veneer Failures	62
Kimball J. Beasley	
Investigation and Repair of a Curtain Wall Damaged by a Blast.....	70
Alexandar J. Mlynarczyk	

Facade

Forensic Façade—Restoration of the Lost Gems of NYC.....	83
Benjamin Lavon and Kendra Logan	
The Tale of Two Stones	90
Derek A. Hodgkin and John C. Wylie	

Weeping Stucco Buckets102
Robert Bateman and Rene Luft

Geotechnical

Interpreting Damage to Existing Structures Adjacent to Construction Sites113
N. B. Smith and M. Vatovec

Determining Damage Contributions from the Loss or Instability of Soil within a Foundation's Influence Zone124
William C. Bracken, Jose Busquets, and Constance Campbell Brashear

A Case Study of Ground Vibrations Due to Pile Driving in Mobile, Alabama132
John C. Cleary, Andrew S. Gillis, and Eric J. Steward

Site Characterization and Evaluation of a Deep-Seated Slope Movement143
Brian E. Ladd

Masonry

Forensic Investigation of Concrete Masonry Wall Cracking154
William C. Bracken and Jose Busquets

Lessons Learnt from the Partial Collapse of a Historical Masonry Building...163
F. Palmisano and A. Vitone

Benefits of Helical Bar Reinforcing in Preserving Historic Masonry Facades.....173
Eric Hammarberg and Jared M. Shoemaker

Failure of a Thin Limestone Facade186
R. Ratakonda, D. B. Peraza, and A. M. Dolhon

Performance of Materials

Thickness Swell in Particle Board: A Forensic Tool for the Duration of Loss196
Brett Davis and Ralph E. Moon

Wood Swelling: Pressures Exerted from Saturated Wood Materials209
N. Wells and R. E. Moon

Needle in a Haystack: Identifying Failure Origin Pieces in Heat-Treated Glass219
Stewart M. Verhulst, A. William Lingnell, and Brenden A. Adams

Electrical Resistivity Measurement to Study Alkali-Silica-Reaction Cracking in Mortar230
J. Flores, M. Kamali, and A. Ghahremaninezhad

Roofing

Hail Impact Testing of Masonite Shingles.....242
Paul J. Bennett, James Staebler, and Stanley C. Stoll

Hail Evaluation of Bituminous Roofing Membranes: Understanding Interply Mopping Voids254
Justin Donaldson, Marco DeLeon, and Stewart Verhulst

Assessing Wind-Damaged Masonite Shingles264
Stanley C. Stoll and Paul J. Bennett

The Anatomy of the Failure of a Wood Panelized Roof Sub-Purlin Hanger.....276
Kenneth Simons, Zeno Martin, and Kip Gatto

Track B

Blast

Richmond Hill Subdivision Explosion Case Study286
James W. Jordan, Andrew J. Sharer, and Ross A. Kimble

Performance of Structures Subjected to the West Fertilizer Company Explosion.....296
Erik L. Nelson and Jeffrey L. Hull

Investigation of the Fragment Impact and Blast Shock Wave on Window Breakage.....308
Sebastian Mendes, Liling Cao, Elisabeth Malsch, and Gary Panariello

Failures during Construction

Column-Reinforcing Cage Stability and Construction Safety318
Cliff D. Bishop and Patxi Uriz

**A Case Study on the Partial Collapse of a Building with a Light
Gage Steel Framing System328**
Ibrahim Erdem and David B. Peraza

**Issues Facing Design Professionals through the Lens of
Two Rain-Induced Roof Collapses.....337**
J. W. Lawson and M. E. Parolini

Prevention of Construction Failures: A Systematic Approach349
Ilias Ortega

Hurricanes

**Hurricane Wind-Generated Debris Impact Damage to the Glazing of a
High-Rise Building.....361**
A. Jain

**Hurricane Andrew: Whatever Happened to My Argument to Abolish
Prescriptive Building Codes?.....371**
Leonard J. Morse-Fortier

**Building Code Changes Resulting from FEMA’s Hurricane Sandy
Mitigation Assessment Team Report.....380**
John Ingargiola, Adrienne Sheldon, and Laura Ghorbi

Evaluation and Repair of Tornado Damage to a Historic Church387
Michael Horst and Benjamin Clemons

Methodology

**The Benefit of Using Bayesian Structural Reliability Language and
Theory in a Forensic Investigation of an Existing Building398**
Gary C. Hart

Case Studies of Finite Element Analysis in Structural Investigations.....409
Nicholas D. Catella

3D Documentation and Printing in Forensics420
Kevin A. Kianka

**Evaluating the Validity and Reliability of Crack Dating Methods in the
U.S. Legal System429**
Laura Sullivan-Green

Seismic and Wind

Structural Damage Allocation from Sequential Earthquakes.....439
B. Arya, A. Jain, C. C. Simsir, D. G. Reyes, and M. Rahmani

Residential 3D Model Wind Tunnel Pressure Testing449
Eric Black and Stanley C. Stoll

**Numerical Investigation of the Failures Observed in Eccentrically-Braced
Frames in the Aftermath of the Christchurch Earthquake Series
(2010–2011).....468**
Reza Imani and Michel Bruneau

**Experimental and Numerical Investigation on the Resistance and Failure
Behavior of Ductile Concrete-Filled Double-Skin Tube Columns Subjected
to Post-Earthquake Fires476**
Reza Imani, Gilberto Mosqueda, and Michel Bruneau

Track C

Collapse

Walkway Collapse at the Botanical Gardens: A Study in Movement483
D. R. Cook and D. J. Kelly

Defining Where Progressive Collapse Protection Is Needed495
Eve Hinman and Douglas L. Patin

Uncertainties in Structural Collapse Mitigation.....503
S. Astarlioglu and S. Marjanishvili

Disproportionate Collapse—How to Check the Computer Analysis.....513
John Abruzzo

Concrete

**Investigation of a Tall Ordinary Reinforced Concrete Frame Building
Utilizing Uncertainty in Limit State Capacity and Demand528**
Gary C. Hart

**A Case Study on the Construction Defects of Reinforced Concrete Walls
with Insulated Concrete Forms539**
Ibrahim Erdem and David B. Peraza

Performance of Industrial Concrete Floors for Wheeled Traffic550
Clemens J. Rossell, Mosen Abdi, Chi-Ping Ted Chen, and Wendell B. Bailey Jr.

**Evaluation and Repair of Insufficiently-Reinforced Precast Concrete
Double Tee Members.....559**
Kevin Conroy and Kurt R. Hoigard

Investigation Methods and Codes and Standards

Systems for Structural Failure Investigations in the United States569
Norbert J. Delatte

**Survey of the Means of Egress Provisions in the Construction Codes
of the City of New York.....579**
Anthony M. Dolhon and Ibrahim Erdem

**Incident Site Management—Managing and Documenting an
Incident Scene589**
S. A. Nesvold and J. R. Panko

Developing the Right Protocol for Investigations600
R. Scott Silvester, Stephen W. Stukey, and Robert P. Antes

Practice Issues and Insurance

Can a Single Flood Event Result in Fungal Growth beneath Tile?608
Kathryn M. Rubin, Erik P. Moore, and Ralph E. Moon

Cross-Confidential Reporting on Structural Safety620
Alastair Soane

**Challenges with a Roof Collapse: Causation, Subrogation, and Structural
Rehabilitation.....628**
David A. VanDerostyne

**Failure Histories of Three Masonry Structures: Liability of the Professional
Figures Involved during the Design and Construction Phases.....638**
P. Provenzano and G. Q. Iddas

Standard of Care

**Forensic Engineering Analysis of the Standard of Care in
Construction Claims650**
Kevin D. Ouellette

The Standard of Care and Ethics of Forensic Engineering Testimony.....660
Joshua B. Kardon

Forensic Engineering—Issues of Transition665
James Cohen

The Peer Review Process in Forensic Engineering.....673
James Cohen

Steel and BIM

Evaluation of a Damaged Steel Commercial Structure, Long Island, NY683
Benjamin Lavon and Bryan Yudkin

Metal Corrosion: A Qualitative Analysis693
N. Wells, C. A. Martinez, M. Bass, and R. E. Moon

Coupon Testing: An Essential Tool for Understanding Historic Steel.....705
Dana M. Wolf and Kevin C. Poulin

Track D

Bridges

Seismic Restoration Cost Curve of Curved Steel Bridges716
Junwon Seo and Heedae Park

Collapses of Single Column Pier Bridges in China.....727
Rui Liu, Yongcheng Ji, and Kevin L. Rens

Finite Element Analysis of Cable-Stayed Strands' Failure Due to Fire736
Hossein Ataei, Mohammadhossein Mamaghani, and Riyad S. Aboutaha

Early Age Cracking in a SHCC Bridge Deck Link Slab.....746
En-Hua Yang, Victor C. Li, and Jishen Qiu

Special Structures I

**Analysis of Design Standards and Recommended Practices for
Agricultural Storage Bins756**
D. A. Wojnowski and Randall Bernhardt

**Partial Failure of a Bulk Storage Facility: Construction Defect vs.
Design Error.....766**
Michael P. Lester

Steel Bin Failure and Partial Collapse of a Coal Processing Plant777
Terence M. Taylor

**Load Testing as Part of the Evaluation of a Recently Constructed Precast
Concrete Parking Structure.....790**
Michael J. Drerup and Steven J. Smith

Special Structures II

The Progressive Collapse of Single-Layer Dome Roof Structures.....803
S. Yan and X. Zhao

**Environmental Loading on Temporary Structures Based on the 2014 NYC
Building Code.....814**
J. H. Andrew, L. Valderruten, E. A. Malsch, and J. Feuerborn Jr.

Buckling Analysis of Arched Structures Using Finite Element Analysis824
Hossein Ataei and Abdel-Salam M. Niazzy

**Field Investigation of a Failed Concrete Cone Spreader inside of a
Cement Mixing Silo835**
Jason D. Gregorie and Luis A. Mariaca

Special Topics I: Wood, Vibration, and Flooring

Establishing In-Place Structural Drying Goals: A Scientific Approach849
Jeffrey M. Wilemon

**Review of the Codes and Standards for Noise and Vibration Investigations in
Buildings860**
Charles DeVore and Eric Ahlberg

**Consideration of Wet Service Conditions on the Performance of Bowstring
Trusses868**
Behnam Arya and Anurag Jain

**Investigation of the Different Types of Seismic Base Isolators for a
Continuous Box Girder Bridge.....878**
Ardalan Sabamehr and Ashutosh Bagchi

Special Topics II: Repair, Ceiling Failures, and Fireproofing

Ceiling Failures888
James W. Jordan, Ross A. Kimble, and Andrew J. Sharer

Investigation of Sprayed Fire-Resistive Material and In Situ Bond Failure	899
Lauren Millman, Elisabeth Malsch, Michele Cyr, and Liling Cao	
Jacking Columns of Existing Structures under Existing Loads.....	909
S. Ali Ashrafi, Lisa Davey, and John Abruzzo	
Numerical Simulation of Cement-Treated Soil Reinforced with Coir Fiber Subjected to Flexural Loading	924
Vivi Angraini, Afshin Asadi, Bujang B. K. Huat, and Agusril Syamsir	