



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

Beyond Failure

Other Titles of Interest

Failure Mechanisms in Building Construction, edited by David H. Nicastro (ASCE Press, 1997). Addresses the question of why buildings fail by presenting a wide range of failure mechanisms and case studies. (ISBN 978-0-7844-0283-2)

Guidelines for Forensic Engineering Practice, edited by Gary L. Lewis (ASCE Committee Report, 2003). Recommends guidelines for five areas important to engineers with a forensic practice: qualifications, investigations, ethics, legal issues, and business. (ISBN 978-0-7844-0688-5)

In the Wake of Tacoma: Suspension Bridges and the Quest for Aerodynamic Stability, by Richard Scott (ASCE Press, 2001). Surveys changes in the design of suspension bridges evolving from the 1940 collapse of the first Tacoma Narrows Bridge. (ISBN 978-0-7844-0542-0)

Lessons from the Oklahoma City Bombing, by Eve E. Hinman and David J. Hammond (ASCE Press, 1997). Documents the incident from a structural standpoint, including the building's construction as well as hazard mitigation steps taken during the rescue/recovery process. (ISBN 978-0-7844-0217-7)

The New Orleans Hurricane Protection System: What Went Wrong and Why, by the ASCE Hurricane Katrina External Review Panel (ASCE, 2007). Focuses on the direct physical causes and contributing factors that led to the failure of the New Orleans hurricane protection systems in 2005. (ISBN 978-0-7844-0893-3)

The Pentagon Building Performance Report, by Paul E. Mlakar, Donald O. Dusenberry, James R. Harris, Gerald Haynes, Long T. Phan, and Mete A. Sozen (ASCE Committee Report, 2003). Presents the results of an exhaustive examination and analysis of the Pentagon's performance during and immediately after the 2001 terrorist attack. (ISBN 978-0-7844-0638-0)

Beyond Failure

Forensic Case Studies for Civil Engineers

Norbert J. Delatte Jr., Ph.D., P.E.



Library of Congress Cataloging-in-Publication Data

Delatte, Norbert J.

Beyond failure: forensic case studies for civil engineers / Norbert I. Delatte. Ir.

Delatie,

p. cm.

Includes bibliographical references and index.

ISBN 978-0-7844-0973-2

- 1. Forensic engineering—Case studies. 2. System failures (Engineering)—Case studies. 3. Civil engineering—Case studies.
- 4. Structural failures—Investigation—Case studies. I. Title.

TA219.D45 2009 624.1'71—dc22

2008045372

Published by American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia 20191 www.pubs.asce.org

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 therefor. 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.

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

Photocopies and reprints. You can obtain instant permission to photocopy ASCE publications by using ASCE's online permission service (http://pubs.asce.org/permissions/requests/). Requests for 100 copies or more should be submitted to the Reprints Department, Publications Division, ASCE (address above); e-mail: permissions@asce.org. A reprint order form can be found at http://pubs.asce.org/support/reprints/.

Copyright © 2009 by the American Society of Civil Engineers. All Rights Reserved.

ISBN 978-0-7844-0973-2

Manufactured in the United States of America.

17 16 15 14 13 12 11 10 09

For my mother, Virginia McClary Delatte, who inspires my teaching.



Contents

FOI	FOREWORD	
	by Kenneth L. Carper	
PRE	PREFACE	
1	Why Case Studies?	1
	Organization of This Book	3
	Notes to the Student	4
	Sources for Case Materials	5
2	Statics and Dynamics	7
	Hyatt Regency Walkway	8
	Tacoma Narrows Bridge	26
	Aircraft Impacts	38
	Other Cases	42
3	Mechanics of Materials	51
	Quebec Bridge	51
	Point Pleasant Bridge Collapse	70
	Comet Jet Aircraft Crashes	82
	Other Cases	86
4	Structural Analysis	89
	Agricultural Product Warehouse Failures	90
	Ronan Point	97

	L'Ambiance Plaza Collapse	107
	Cleveland Lift-Slab Parking Garage	121
	Kemper Arena	124
	Other Cases	126
5	Reinforced Concrete Structures	129
	Air Force Warehouse Shear Failures	130
	2000 Commonwealth Avenue	133
	Skyline Plaza in Bailey's Crossroads	144
	Harbour Cay Condominium	149
	Bombing of the Oklahoma City Murrah	
	Federal Building	155
	The Pentagon Attack	162
	Other Cases	167
6	Steel Structures	173
	Hartford Civic Center Stadium Collapse	174
	Mianus River Bridge Collapse	184
	Cold-Formed Steel Beam Construction Failure	188
	The World Trade Center Attacks	195
	Pittsburgh Convention Center Expansion	
	Joint Failure	206
	Minneapolis I-35W Bridge Collapse	211
	Other Cases	215
7	Soil Mechanics, Geotechnical	
	Engineering, and Foundations	221
	Teton Dam	223
	Vaiont Dam Reservoir Slope Stability Failure	234
	The Transcona and Fargo Grain Elevators	249
	Other Cases	255
8	Fluid Mechanics and Hydraulics	257
	Johnstown Flood	257
	Malpasset Dam	267
	Schoharie Creek Bridge	277
	New Orleans Hurricane Katrina	
	Levee Failures	287
	Other Cases	299

ix

9	Construction Materials	301
	Austin Concrete Dam Failure	303
	Liberty Ship Hull Failures	310
	Willow Island Cooling Tower Collapse	316
	Boston's Big Dig Tunnel Collapse	325
	High-Alumina Cement	330
	Other Cases	330
10	Management, Ethics, and Professional	
	Issues	333
	Citicorp Tower	333
	Space Shuttle Challenger	345
	Sampoong Superstore, Korea	352
	Misuse of the Professional Engineer License	357
	Property Loss Investigations	359
Арр	ENDIX A: Notes to the Professor	361
APPENDIX B: The ASCE Code of Ethics		377
Appendix C: Some Cases on Video and DVD		385
REFERENCES		391
INDEX		403
ABOUT THE AUTHOR		407