
PERSPECTIVES IN CIVIL ENGINEERING

*Commemorating the
150th Anniversary of the
American Society of Civil Engineers*

American Society of Civil Engineers



Building a Better World

EDITED BY
JEFFREY S. RUSSELL

ASCE

Published by the American Society of Civil Engineers

Library of Congress Cataloging-in-Publication Data

Perspectives in civil engineering : commemorating the 150th anniversary of the American Society of Civil Engineers / edited by Jeffrey S. Russell.

p. cm.

Includes bibliographical references and index.

ISBN 0-7844-0686-3

1. Civil engineering--History. 2. American Society of Civil Engineers--History. I. Russell, Jeffrey S. II. American Society of Civil Engineers.

TA19.P45 2003

624'.09--dc22

2003060160

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

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Library of Congress Catalog Card No: 2003060160

ISBN 0-7844-0686-3

Manufactured in the United States of America.

Foreword

I remember my conversations with Bruce Gossett more than 5 years ago as this volume was literally being conceived. What a treasure and benefit for future generations to have a snapshot of the profession at the outset of the 21st century as told by the leading experts in their respective fields. While I had a small part in organizing this publication, there is no denying that this project would never have gotten off the ground if it were not for the dedication of the ASCE staff and the eminent authors themselves who worked tirelessly to bring this volume to life. This volume is the direct result of their work and passion for civil engineering, and is the principal reason that this book is such a success.

As editor of this project, I would like to thank Bruce Gossett, Johanna Reinhart, Charlotte McNaughton, Suzanne Coladonato, and Jackie Perry for their administrative and editorial expertise and support. We also want to thank all the editors of the ASCE journals who considered participating, and especially those editors who helped contact and coordinate expert authors to write these landmark papers, and then facilitated the peer review process of each paper. These editors are listed with the appropriate journal title in the table of contents.

On behalf of ASCE, I would like to thank each of the authors for not only their papers, but their contributions to the civil engineering profession. They are (in alphabetical order): Pedro Albrecht, C. E. Bakis, L. C. Bank, Zdenek P. Ba ant, Haym Benaroya, Arnon Bentur, Leonhard Bernold, Herman Bouwer, Richard Bradshaw, V. L. Brown, Darcy Bullock, David Campbell, Ching-Jen Chen, Koon Meng Chua, E. Cosenza, J. F. Davalos, Scott A. David, Norbert J. Delatte, Marshall J. English, Steven J. Fenves, Kenneth J. Fridley, Mousa Gargari, Francis E. Griggs, Jr., Mark E. Grismer, Terry T. Hall, Jr., Yousef Haik, Chris T. Hendrickson, Glenn J. Hoffman, Milan Jirásek, Futoshi Katsuki, C. G. Keyes, Jr., J. J. Lesko, Herbert S. Levinson, Zongzhi Li, James A. Liggett, Dallas N. Little, Richard W. Lyles, A. Machida, Amir Mirmiran, Sudhir Misra, Louay N. Mohammad, Hiroshi Mutsuyoshi, Thomas M. Petry, A. L. Prasuhn, A. Essam Radwan, William J. Rasdorf, Kevin L. Rens, S. H. Rizkalla, Freddy L. Roberts, Jose M. Roëssset, Robert H. Scanlan, Cliff J. Schexnayder, Vijay P. Singh, Kumares C. Sinha, Kenneth H. Solomon, K. K. Tanji, T. C. Triantafillou, Patrick Tripeny, Taketo Uomoto, Wesley W. Wallender, L. B. Wang, Richard Weingardt, David A. Woolhiser, and James T. P. Yao. Regretfully, two of the authors, Neal FitzSimons and Paul R. Wolf, have passed away.

As with all projects of this magnitude, there were countless people involved. To everyone not named who participated in this historic volume, I offer heartfelt thanks and gratitude.

Introduction

Let us consider how significantly and fundamentally the practice of civil engineering has changed over the past 150 years. Gone are the compass, chain, and slide rule, and here to stay are the advanced technologies, including global positioning and virtual 4-D design that are reshaping the very nature of the civil engineering enterprise. Gone are the ox-drawn cart and makeshift building elements. They have been replaced with increasingly automated and adaptable mechanized tools and innovative building materials. Gone too are the hardships of roughing out railroad track in the American wilderness, but here to stay are the systems-level concerns that are challenging the very core of the profession. Finally, gone are the days when the civil engineer could afford to operate in a local context only, without considering the regional and environmental impact of design. Here to stay are the days that the civil engineer must become responsible for offering system-level analysis for clients, the architectural / engineering / construction industry, and the public at large.

The civil engineering enterprise is becoming increasingly infused with nano-, bio-, and information technology. Buildings, structures, and materials are growing “smarter” as wireless sensors, self-healing materials, and integrated systems are providing greater control and information about operating state and performance. That information that can be uploaded into the design and operation of future structures. New construction, especially the grand and symbolic civil works projects of the past, is decreasing while re-construction, refurbishment, and ever-more-intricate additions to the aging infrastructure dominate the public landscape. On most every project, public or private, there has been a shift from a frontier, grass roots philosophy with little awareness for how projects affect environmental or social systems to a new outlook that is global, sustainable, and community-based in scope. Rather than accept as inevitable and then treat pollution and waste, comprehensive efforts are regularly taken to design out inefficiencies through recycling, greener materials, and better reliability and maintainability. The public has become a valued and courted stakeholder, and public hearings and meetings are becoming regular and important forums and milestones in the design process. The stove-piped, segmented project process of the past, with experts passing their knowledge over the fence to other experts downstream, is being replaced with integrated and fluid project processes, not only from design-builders but from the increasing use of cross-functional teams, pre-project planning, asset management, and designing for maintainability, sustainability, life cycle cost, and safety and security.

This is an exciting time for civil engineers, but we find ourselves at a time of transition. As the papers in this book attest, civil engineering has grown in size, complexity, and scope since ASCE was founded in 1852. Civil engineering was once a refined art passed down primarily in the field by seasoned practitioners, in which

field-derived solutions were commonplace and in many ways definitive practice. Civil engineering has become a multi-pronged discipline emphasizing planning, scientifically based solutions, and specialized expertise. What has not changed in this transition from a learned art to a studied profession, I believe, is the spirit behind this great endeavor and the Society that unites it. The men who founded ASCE and the men and women who constitute ASCE today share a common interest in building a better world, quite literally. We are engineers because we want to know how things work, and we want to make them work better. We are *civil* engineers because we want to see the orthogonal lines on schematics grow into hospitals, water treatment plants, and safe roads and highways; we want to improve the quality of life for our citizens; and we want to know that we, in our own unique ways, are making a difference.

The vision of ASCE is, after all, “Engineers as global leaders building a better quality of life.” It’s all there in that one statement—the focus on the international context, the belief that the built environment shapes and contributes to societal well-being, and the desire to serve others. These traits are the spirit of the profession, and in this volume they are discussed and celebrated. What is also in that statement, though we may not recognize it at first sight, is change. The verb *build* implies that we are making and remaking the world, that we are, in essence, agents of change. While change is never easy, we are a profession whose very existence is rooted in transformation, and therefore, we are forever learning, growing, and changing. We find ourselves at a point when we must reflect on where we have been, where we stand, and most importantly, where we are going.

As you will see thumbing through these pages, the papers collected here perform this task quite admirably and excitingly, as they celebrate the history, heritage, and accomplishments of the profession while assessing the state-of-the-art and future challenges. Each paper explores a particular aspect of civil engineering knowledge and practice. The authors, experts who have mastered their fields and helped shape the profession, present the cutting-edge research and the notable people and projects in their respective fields. While these papers collectively provide a snapshot of the profession, each one has an eye towards the future. They offer predictions and likely developments in the years to come, especially regarding the needs of ASCE and the civil engineering profession.

As editor of this volume I have had the unique privilege to watch this important document take shape, and if I may be so bold, I would like to highlight a few of the themes that emerge. We have come a long way since the founding of the Society, but in some ways, perhaps, we have strayed too far in certain directions, and not far enough in others. At the outset of the 21st century, the civil engineering profession is faced with many challenges and opportunities. If the profession is to grow in prestige, efficacy, and reputation, we must confront the challenges before us. Most

importantly, we must become better able to accommodate, predict, and embrace change in the complex arena of modern practice.

In response to increased complexity, we have become a highly specialized profession, mastering subsets of knowledge in order to contribute as a team-member to certain aspects of a project. While this strategy has worked quite admirably, it may not be the best strategy to foster sustainability and life cycle costing, while designing to minimize waste and vulnerability. If we are to become leaders of the built and natural environments, we need to broaden our scope from the educational foundation on up to expectations of professional practice.

Time and again these papers implicitly and explicitly call for individuals capable of integrating and synthesizing various domains of knowledge into systems-level understanding. You can see the authors grappling with this concept as they call for merging scales (micro and macro), maximizing benefits, achieving multi-objective optimization, taking a regional view, and designing complete systems as opposed to discrete subsystems and components. Now more than ever, it is paramount for civil engineers to embrace their role as the single profession that makes it their business, their expertise, and their mission to understand, address, and manage the built and natural environments. We must become the profession that excels at system-level planning, despite increasing levels of uncertainty and risk, because if we do not, other professions with leadership and management skills will fulfill this crucial project role.

Which brings me to a second thread running through these papers. As a profession we continue to struggle with the soft side of engineering, and to fulfill our roles as the master integrators and technical leaders of the 21st century, we must embrace a more holistic and realistic definition of what our purpose is and how we can achieve it. The future will demand new knowledge, skills, and attitudes from civil engineers, and to provide a foundation for life long learning and excellence, the profession must continue to set high expectations in education and practice. This includes not only advancing our technical knowledge, but our understanding of leadership, communication, teamwork, and management—what many are calling professional skills. While civil engineers should continue to provide technical expertise and consultation, we must also position ourselves as the team leaders, project leaders, and public policy experts who help our country and the world confront fresh water supplies, irrigation, waste management, an aging infrastructure, and quickly depleting natural resources.

To realize our full potential, we must develop and hone our communication and facilitation skills in order to bring various constituencies together to balance the multiple perspectives and interests facing every project. Technical solutions, by themselves, are no longer the sole measure of project success; optimizing engineering solutions to meet multiple criteria, whether environmental, social, or economic, are increasingly defining professional practice. Accordingly, these papers call again and

again for a well-rounded practitioner of the future, with a foundation in liberal arts and professional skills complementing a solid technical background, an understanding of systems, and a personal commitment to life-long learning and continuous improvement.

Finally, these papers themselves serve as models of the well-written argument, embodying a holistic concern for specialties within the larger profession and a wider world beyond technical problems and solutions. Their very existence is proof that civil engineers can and do possess the kind of insight and perspective necessary to confront the challenges of the 21st century. It is our professional duty to embody the perspectives so powerfully articulated in this volume as we strive to uphold the ASCE Mission: “To provide essential value to our members, their careers, our partners, and the public through: Developing Leadership, Advancing Technology, Advocating Lifelong Learning, and Promoting the Profession.”

The choice is ours: we create our future and destiny. What will future observers 30 or 100 or 150 years hence think about this volume and our profession? Will civil engineers be the master integrators and technical leaders of the built and natural environments, engaged in the critical discussions related to our planet’s resources and management, and thereby enhancing the quality of life? Will we even continue as one group, united to serve the betterment of humankind through well-conceived projects and facilities? We cannot hope to answer these questions for that future reader, but we can answer these questions for ourselves and for our profession today. As we look to the future, let us be mindful of the men and women who have made our profession strong, reliable, and respected. As Albert Einstein said, we are standing on the shoulders of giants. Let each of us continue to improve the profession for all civil engineers—past, present, and future—by seizing the opportunity to make civil engineers leaders of the 21st century and beyond.

Jeffrey S. Russell, P.E., Ph.D.
Madison, WI
June 30, 2003