



Sustainable Transportation Systems

Plan, Design, Build,
Manage, and Maintain



Proceedings of the 9th Asia Pacific Transportation
Development Conference

Edited by Yong Bai, Ph.D., P.E., Wei-Chou Virgil Ping, Ph.D., P.E.,
L. David Shen, Ph.D., P.E., and Xiaohu Chen, Ph.D.

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SUSTAINABLE TRANSPORTATION SYSTEMS

PLAN, DESIGN, BUILD, MANAGE, AND MAINTAIN

PROCEEDINGS OF THE NINTH ASIA PACIFIC TRANSPORTATION
DEVELOPMENT CONFERENCE

June 29–July 1, 2012
Chongqing, China

SPONSORED BY

International Chinese Transportation Professionals Association
T. Y. Lin International Group, China
Chongqing Urban Planning Bureau, China
Chongqing Jiaotong University
Chongqing Rail Transit (Group) Co. Ltd.
Chongqing Transport Planning Institute
The Transportation & Development Institute (T&DI)
of the American Society of Civil Engineers

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Published by the American Society of Civil Engineers

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Cataloging-in-Publication Data on file with the Library of Congress.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, Virginia, 20191-4400

www.pubs.asce.org

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ISBN 978-0-7844-1229-9
Manufactured in the United States of America.

Preface

We would like to welcome you to the 9th Asia Pacific Transportation Development Conference sponsored by the International Chinese Transportation Professionals Association (ICTPA), T.Y. Lin International Group, Chongqing Urban Planning Bureau, and the Transportation and Development Institute of the American Society of Civil Engineers (ASCE) and hosted by T.Y. Lin International China, Chongqing Jiaotong University, Chongqing Rail Transit (Group) Co. Ltd, and Chongqing Transport Planning Institute. The theme of the conference is “Sustainable Transportation System.”

Transportation professionals are facing continuous challenges including endless traffic congestion, ever-worsening environmental impacts, rising energy cost and deteriorating quality of life. To meet these challenges requires new innovations to develop sustainable transportation systems through planning, design, build, management, and maintenance. This special publication produced by the ASCE is one of several official proceedings of the conference. The ASCE proceedings include 81 peer-reviewed papers addressing nine major areas including: 1) Sustainable Transportation Development; 2) Low Carbon Emissions and Energy Saving in Transportation, 3) Multi-modal Transportation System, 4) Intelligent Transportation Systems, 5) Advancements in Traffic Control Technologies, 6) Transportation and Work Zone Safety, 7) Design and Construction of Bridges and Tunnels, 8) Pavement Materials, Design and Construction, and 9) Geotechnical Design and Construction. Recent advances in new strategies, new methods, and new technologies are presented to address topics relating to funding, planning, design, construction, maintenance, and management of transportation facilities including aviation, port, harbor, highway, bridge, tunnels, rapid transit, and railroad.

One of the conference organizers is the ICTPA, a 25-year-old professional organization that has conducted conferences throughout North America and Asia to examine local and global transportation development issues. With the rapid growth in the recent years, China has become one of the largest transportation infrastructure markets in the world. Many authors studied transportation development in China have showcased new ideas and approaches emerged from some of the world’s largest transportation projects in that country. On the other hand, practitioners and scholars from the United States and other developed countries and regions have presented latest advances in transportation system management and maintenance. The unique combination of these two main streams presented by a distinguished group of international recognized practitioners and scholars has provided a wide range of stimulation and inspiration in solving global transportation problems.

We believe that the proceedings will be invaluable to transportation professionals in advancing their career. In closing, we hope that you enjoy the conference and the City of Chongqing and catch up with old friends and colleagues and make new ones.

Man-Chung Tang, Ph.D., P.E., Hon.M.ASCE
Honorary Conference Chairman
Chairman of the TY Lin International Group

Endi Zhai, Ph.D., P.E., G.E.
Conference Chairman
President of the ICTPA

Acknowledgments

The organizers of the 9th Asia Pacific Transportation Development Conference would like to thank the T.Y. Lin International Group, China to provide financial support for the production of the ASCE proceedings. The Conference Organizing Committee, the Technical Committee, and the International Advisory Committee should be acknowledged for their dedication and contributions to the success of the conference programs.

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The organizers would also like to acknowledge many people, whose names are not shown above, have contributed their knowledge, time, and energy to make the conference successful.

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