Preface

The first ICPT conference was held in 1993 in Singapore. Since then, six (6) more conferences were conducted in five (5) countries over the last twenty (20) years. Following the footsteps of the previous seven events, the 8th International Conference on Road and Airfield Pavement Technology (ICPT'2013) is being held in Taipei, Taiwan, from July 14 to 18, 2013. ICPT'2013 is organized by Chinese Society of Pavement Engineering (CSPE, Taiwan) and sponsored by CSPE and International Committee on Road and Airfield Pavement Technology (ICPT). Conference co-sponsors include Public Construction Commission (Taiwan), Ministry of Transportation and Communications (Taiwan), Ministry of Education (Taiwan), Bureau of Foreign Trade (Taiwan), Construction and Planning Agency (Taiwan), National Science Council (Taiwan), Taipei City Government (Taiwan), Taiwan Taoyuan International Airport, CECI Engineering Consultants, Inc. (Taiwan), Taiwan Industrial Asphalt Association, National Central University (Taiwan), Feng-Chia University (Taiwan), American Society of Civil Engineers (ASCE), Transportation Research Board (TRB), and International Association of Chinese Infrastructure Professionals (IACIP).

ICPT'2013 is a premier forum for exchange of innovations, recent research findings, new advancements, etc. in the fields of highway and airfield pavement technology. The conference brings together researchers and practitioners from academia, government officials, and industries at home and around the world to discuss and share ideas and latest advancements in the highway and airfield pavement engineering and related areas. More than 200 papers are being presented in the conference and a record-breaking attendance of more than 800 people is expected. All papers have been subjected to vigorous peer reviews by at least two (2) experts with relevant expertise. Their efforts are essential to the success of the conference and are greatly appreciated.

This volume contains partial papers presented in the conference and is divided into seven (7) chapters: Pavement Design, Evaluation and Performance; Pavement Materials; Sustainability in Pavement Engineering; Pavement Maintenance, Rehabilitation, and Preservation; Pavement Management Systems; Construction and Transportation Engineering; and Airfield Pavement. This volume will serve as valuable resources and references for all conference participants for their future research studies.

We would like to express our sincere appreciations to Trans Tech Publications for producing this volume; to all authors for their contributions to this volume; and to all invited keynote speakers, sponsors, and delegates for making the ICPT'2013 a successful event.

Joh Dong Lin

Chairman of the Organizing Committee of ICPT'2013

Sponsors and Committees

General Chair

Jyh-Dong Lin, National Central University. Taiwan

Scientific Committee Chairs

A. Veeraragavan, Indian Institute of Technology Madras, India

Andreas Loizos, National Technical University of Athens, Greece

Behrooz Saghafi, Tarahan Parseh Transportation Research Institute, Iran

Chiu Liu, California Department of Transportation, USA

Chung Wu (Co-Chairman), Virginia Department of Transportation, USA

Deng-Fong Lin (Co-Chairman), I-Shou University, Taiwan

Erol Tutumluer, University of Illinois at Urbana-Champaign, USA

Eshan V. Dave, University of Minnesota, USA

Feipeng Xiao, Clemson University, USA

Francesco Canestrari, University Politecnica delle Marche, Italy

Gordon Airey, University of Nottingham, UK

Hamid Nikraz, Curtin University of Technology, Australia

Hao Wang, Rutgers, The State University of New Jersey, USA

Huan-Lin Luo, I-Shou University, Taiwan

Hugo M.R.D. Silva, University of Minho, Portugal

Ibrahim Mohammad Asi, Hashemite University, Jordan

Jian-Shiuh Chen, National Cheng-Kung University, Taiwan

K. Wayne Lee, University of Rhode Island, USA

Linbing Wang, Virginia Tech, USA

Lisa Y. Chen, I-Shou University, Taiwan

Marco Pasetto, University of Padua, Italy

Mofreh Saleh, University of Canterbury, New Zealand

Mujib Rahman, Nottingham Trent University, UK

Musharraf Zaman, University of Oklahoma, USA

Salvatore Cafiso, University of Catania, Italy

Shin-Che Huang, Western Research Institute, USA

Shuan-Fa Chen, Chang'an University, China

Sigurdur Erlingsson, University of Iceland, Iceland

Susan L. Tighe, University of Waterloo, Canada

Ta-Peng Chang, National Taiwan University of Science and Technology, Taiwan

Xiaoning Zhang, South China University of Technology, China

Yichang (James) Tsai, Georgia Institute of Technology, USA Yingwu Fang, Virginia Department of Transportation, USA Yoo Jun, Korea Institute of Constructing Technology, Korea York Ying-Haur Lee, Tamkang University, Taiwan Zhanping You, Michigan Technological University, USA Zhen Leng, Hong Kong Polytechnic University, Hong Kong

International Executive Committee Chairs

Atsushi Kasahara, Hokkaido Institute of Technology, Japan Bagus H. Setiadji, Diponegoro University, Indonesia David Hosin Lee, University of Iowa, USA Direk Lavansiri, Chulalongkorn University, Thailand Gary Chai, Griffith University, Queensland, Australia Haiqing Wang, China Academy of Transportation Sciences, China K. S. Reddy, Indian Institute of Technology, India Kelvin Lee, Samwoh Corporation Pte Ltd, Singapore Kunnawee Kanitpong, Asian Institute of Technology, Thailand Kwang W. Kim, Kangwon National University, Korea Low Boon Hwee, Hanson Building Materials, Malaysia Mohd Rosli Hainin, University of Technology, Malaysia S. S. Jain, Indian Institute of Technology Roorkee, India T. F. Fwa (Chairman), National University of Singapore, Singapore Taeson Park, National University of Technology, Korea Tan Hua Soon, Pavement Engineering Society Singapore Wei-Hsing Huang, National Central University, Taiwan Zahidul Hoque, Australia

International Advisory Committee Chairs

Akira Kawamura, Kitami Institute of Technology, Japan Andrew Collop, Nottingham Center for Pavement Engineering Transportation Engineering Center, UK

Gilbert Baladi, Michigan State University, USA
Jeff Gagnon, Airport Pavement Sub-Team, AJP-6312, William J Hughes Technical Center, USA
Richard Kim, NC State University, USA

T. F. Fwa, National University of Singapore, Singapore

Local Committee: Honorary Advisory Committee Chairs

Chao-Ke Ku, Director, Public Work Bureau of Taoyuan County Government, Taiwan

Chen-Pong Yin, Director, Civil Aeronautics Administration, MOTC, Taiwan

Chi-kuo Mao (Chairman), Vice Premier, Executive Yuan, Taiwan

Der-Jen Tseng, Director, Taiwan Area National Freeway Bureau, MOTC, Taiwan

Hsien-Heng Lee, Commissioner, Public Works Department of Taipei City Government, Taiwan

Jenn-chuan Chern (Co-Chairman), Minister, Public Constructing Commission, Taiwan

Lung-Bin Hau (Co-Chairman), Mayor, Taipei City Government, Taiwan

Men-Feng Wu, Director, Directorate General of Highways, MOTC, Taiwan

Shih-Wen Yeh (Co-Chairman), Director, Constructing and Planning Agency, Ministry of the Interior, Taiwan

Tsai-Wen Kuo, Chairman, Taiwan Taoyuan International Airport, Taiwan

Tsung-Cheng Kao, Chairman, Public Work Department, New Taipei City Government, Taiwan

Wei-Ling Chiang (Co-Chairman), Minister, Ministry of Education, Taiwan

Local Committee: Organizing Committee Chairs

Ai-Chin Chen, National Taiwan University, Taiwan

Chia-Pei Chou (Co-Chairman), National Taiwan University, Taiwan

Chien-Cheng Chou, National Central University, Taiwan

Chih-Yuan Chu, National Central University, Taiwan

Der-Hsien Shen (Co-Chairman), National Taiwan University of Science and Technology, Taiwan

Hao-Hsien Chen, National Ilan University, Taiwan

Jia-Ruey Chang, Minghsin University of Science and Technology, Taiwan

Jian-Neng Wang, National Yunlin University of Science and Technology, Taiwan

Jyh-Dong Lin (Chairman), National Central University, Taiwan

Ming-Feng Kuo, Central Taiwan University of Science and Technology, Taiwan

Pan-Ao Tsai (Senior Advisor), Honorary Chairman, Chinese Society of Pavement Engineering,

Taiwan

Pei Liu (Co-Chairman), Feng-Chia University, Taiwan

Ping-Sien Lin, National Chung Hsing University, Taiwan

Shih-Hsien Yang, National Cheng Kung University, Taiwan

Tung-Wen Hsu, National Chung Hsing University, Taiwan

Wei-Hsing Huang (Co-Chairman), National Central University, Taiwan

Local Committee: Secretary Office

Chia-Chen Wu, Chinese Society of Pavement Engineering, Taiwan

Chia-Tse Hung, Chinese Society of Pavement Engineering, Taiwan

Chia-Wen Lin, Chinese Society of Pavement Engineering, Taiwan

Chien-Ta Chen, Chinese Society of Pavement Engineering, Taiwan

Ching-Tsung Hung (Deputy Secretary General), Kainan University, Taiwan

Chiung-Hua Du, Chinese Society of Pavement Engineering, Taiwan

Joy Jiu Zhang, Chinese Society of Pavement Engineering, Taiwan

Kai-Chun Hsu, Chinese Society of Pavement Engineering, Taiwan

Shih-Huang Chen (Secretary General), Feng-Chia University, Taiwan

Shiow-Ronr Tsai, Chinese Society of Pavement Engineering, Taiwan

Shyuan Lin, Chinese Society of Pavement Engineering, Taiwan

Tsung-Po Hung, Chinese Society of Pavement Engineering, Taiwan

Tzu-Yi Wu, Chinese Society of Pavement Engineering, Taiwan

Pei-Pei Pao, Chinese Society of Pavement Engineering, Taiwan

Wei-Yu Chen, Chinese Society of Pavement Engineering, Taiwan

Yen-Kai Liao, Chinese Society of Pavement Engineering, Taiwan

Yu-Jhen Liu, Chinese Society of Pavement Engineering, Taiwan

Yu-Min Su, Chinese Society of Pavement Engineering, Taiwan

Yi-Ting Chao, Chinese Society of Pavement Engineering, Taiwan

Yi-Yang Cheng, Chinese Society of Pavement Engineering, Taiwan

Co-sponsored by

American Society of Civil Engineers (ASCE)

Bureau of Foreign Trade, Ministry of Economic Affairs (MOEA), Taiwan

CECI Engineering Consultants, Inc., Taiwan

Chinese Society of Pavement Engineering, Taiwan

Civil Aeronautics Administration, Ministry of Transportation and Communications (MOTC),

Taiwan

Construction and Planning Agency, Ministry of the Interior, Taiwan

Directorate General of Highways, Ministry of Transportation and Communications (MOTC),

Taiwan

Feng-Chia University, Taiwan

International Association of Chinese Infrastructure Professionals (IACIP)

International Committee on Road and Airfield Pavement Technology (ICPT)

Ministry of Education, Taiwan

Ministry of Transportation and Communications (MOTC), Taiwan

National Central University, Taiwan

National Science Council, Executive Yuan, Taiwan

Public Construction Commission, Executive Yuan, Taiwan

Public Work Bureau, Taoyuan County Government, Taiwan

Public Work Department, New Taipei City Government, Taiwan

Public Works Department, Taipei City Government, Taiwan

Taiwan Area National Freeway Bureau, Ministry of Transportation and Communications (MOTC),

Taiwan

Taiwan Industrial Asphalt Association, Taiwan

Taiwan Taoyuan International Airport, Taiwan

Transportation Research Board (TRB)