

Preface

eco-AWAM International Conference on Civil Engineering 2015 (eco-AICCE'15) is a conference dedicated to the sustainability of infrastructures and related topics. It is the second international conference organized by the School of Civil Engineering, Universiti Sains Malaysia (USM) after the successful AICCE'12 & GIZ'12 held in Penang in 2012. AWAM is the word for Civil as used in the term 'Civil Engineering'. It was also used in the titles of five earlier national conferences in a series organized by the School of Civil Engineering, namely AWAM'99, AWAM'01, AWAM'04, AWAM'07 and AWAM'09 which was the precursor to the current series of international conferences. The prefix eco is used to commemorate the occasion that AICCE'15 is held in parallel with 'ecobuild Southeast Asia 2015' .

eco-AICCE'15 carries the theme "Propelling the Nation's Competitiveness through Sustainable Infrastructure". It is held in conjunction with the International Construction Week 2015 (ICW2015) and co-hosted by Construction Industry Development Board Malaysia (CIDB). CIDB and USM through School of Civil Engineering are both actively promoting the importance of ensuring sustainable infrastructure and infrastructure sustainability. This collaborative endeavor between the two parties has been formalized in the form of a Memorandum of Understanding (MoU) signed in 2015.

This proceedings of eco-AICCE'15 is a collection of 114 papers covering every major field of civil engineering and related areas. The papers present the most recent innovations and trends and also address concerns, practical challenges and solutions towards ensuring sustainability in the infrastructures and the associated activities. The collection of papers are directly or indirectly related to the following four major stages in the life span of an infrastructure project: (i) concept ; (ii) design; (iii) implementation ; (iv) operation.

The editors would like to thank all contributing authors and co-authors for their papers. Appreciation is also extended to all reviewers for their precious time and effort in ensuring that the papers have the quality needed to match the significance of the conference. The editors would also like to express their gratitude to the Technical Review Committee and the Proceedings & Publication Committee for their tremendous effort in ensuring the timely publication of the volume. Finally, the support of all members of eco-AICCE'15 organizing committee, of CIDB and USM, is also gratefully acknowledged.

The editors sincerely hope that this proceedings will serve as an important reference document for academics, researchers, and practitioners from private and public sectors dealing with the subjects of sustainable infrastructure and infrastructure sustainability.

**Assoc. Prof. Dr Choong Kok Keong
Chairman
Eco-AICCE'15 Organizing Committee**

Committees

A. Organizing Committee

1. Prof. Dr. Ahmad Farhan Mohd Sadullah (Advisor)
2. Assoc. Prof. Dr. Choong Kok Keong (Chairman)
3. Dr. Lau Tze Liang
4. Dr. Nastaein Qamaruz Zaman
5. Assoc. Prof. Dr. Norazura Muhamad Bunnori
6. Dr. Remy Rozainy Mohd Arif Zainol
7. Assoc. Prof. Dr. Rozi Abdullah
8. Dr. Fadzli Mohamed Nazri
9. Dr. Md Sayuti Ishak
10. Dr. Izwan Johari
11. Dr. Syarifah Akmam Syed Zakaria
12. Dr. Mastura Azmi
13. Assoc. Prof. Sr. Dr. Mohd Sanusi S.Ahamad
14. Dr. Nur Sabahiah Abdul Sukor
15. Assoc. Prof. Ir. Dr. Leong Lee Vien
16. Dr. Muhd Harris Ramli

B. International Advisory Committee

1. Dr. Jan Valentin, Czech Technical University in Prague, Czech Republic
2. Prof. Cho Yong-Sik, Hanyang University, South Korea
3. Prof. Hoe I. Ling, Columbia University, USA
4. Prof. Hitoshi Morikawa, Tokyo Institute of Technology, Japan
5. Prof. Van-Thanh-Van Nguyen, McGill University, Canada
6. Prof. Enri Damanhuri, Institut Teknologi Bandung, Indonesia
7. Prof Ng Wun Jern, Nanyang Technological University, Singapore
8. Prof. Kaoru Takara, Kyoto University, Japan
9. Prof. Christopher Preece, Universiti Teknologi Malaysia, Malaysia
10. Prof. Shamshad Ahmad, Jamia Millia Islamia University, New Delhi, India
11. Prof. Zhang Min Hong, National University of Singapore, Singapore
12. Dr. Mohammad Maslehuddin , King Fahd University of Petroleum & Minerals, Saudi Arabia
13. Prof. Junji Kiyono, Kyoto University, Japan
14. Prof. Abdulaziz Mohammed Al-Bassam, King Saud University, Saudi Arabia

Organizer: School of Civil Engineering, Universiti Sains Malaysia

Co-Host: Construction Industry Development Board Malaysia (CIDB)