

E A C E F<sub>2013</sub>

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Singapore, 26 – 28 June 2013

*Innovations in Civil Engineering for  
Society and the Environment*



Editors:  
Djwantoro Hardjito & Antoni

Organized by:



**Proceedings of The 4<sup>th</sup> International Conference of Euro Asia  
Civil Engineering Forum 2013 (EACEF 2013),  
National University of Singapore, 26-27 June 2013**

# ***Innovations in Civil Engineering for Society and the Environment***

Edited by:

**Djwantoro Hardjito & Antoni**

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**E A C E F 2013**  
**SINGAPORE**

**The 4<sup>th</sup> International Conference of Euro Asia Civil Engineering Forum 2013**

***Innovations in Civil Engineering for Society and the Environment***

**Conference date**

26-27 June 2013 (Wed, Thu - 2 full days)  
28 June 2013 (Fri - technical visit)

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Faculty of Engineering,  
National University of Singapore

**Organizers**

National University of Singapore, SINGAPORE  
Universitas Pelita Harapan, INDONESIA  
Universitas Atma Jaya Yogyakarta, INDONESIA  
Petra Christian University, INDONESIA

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## PREFACE

This book is the proceedings of 'The 4th International Conference of Euro Asia Civil Engineering Forum 2013 (EACEF 2013)', held at the National University of Singapore, from 26 to 28 June 2013. The conference is hosted by The National University of Singapore (NUS), in collaboration with three universities from Indonesia, i.e. Universitas Pelita Harapan, Jakarta; Universitas Atmajaya, Yogyakarta; and Petra Christian University, Surabaya

*The theme of EACEF 2013 is '**Innovations in Civil Engineering for Society and the Environment**'. The conference brings together academicians, researchers and practitioners, especially in Civil Engineering field, from many different countries in Asia and Europe to exchange ideas and experiences, and to strengthen network among them.*

As this publication represents a wealth of knowledge of eminent researchers and engineers involved in many different areas in Civil Engineering, it is hoped that this conference proceedings will become a useful resource.

Djwantoro Hardjito & Antoni

*Editors*

*Petra Christian University, Surabaya, Indonesia*

*June 2013*

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