

# ADVANCED STEEL CONSTRUCTION

*An International Journal*

Volume 4 Number 2

June 2008

CONTENTS

## Technical Papers

Preface : *S.P. Chiew*

A Performance Evaluation of the Arch Bridge Members Using the Strain Index Based on the Parameters Obtained from Linear Buckling Theory

*Sujaritpong Atavit and Toshitaka Yamao*

Fatigue Strength Characteristics of Welded Stud Joint with Respect to Steel Plate Thickness

*John S.E. Koh, O. Minata and A. Muranaka*

Aesthetics, Economics and Design of Stainless Steel Structures

*Leroy Gardner*

Behaviour and Design of Steel-Concrete-Steel-Sandwich Construction

*N. Foundoukos, M. Xie, J.C. Chapman*

Stress Analysis and Fatigue Test on Partially Overlapped CHS K-Joints

*T. Sopha, T.B.N. Nguyen, S.P. Chiew, C.K. Lee and S.T. Lie*

Structural Efficiency of Deployable Strut-Tensioned Membrane Structures

*T.C. Tran and J. Y. R. Liew*

Behaviour and Design of Aluminum Alloy Structural Members

*Ji-Hua Zhu and Ben Young*

ISSN 1816-112X

Copyright © 2008 by :

The Hong Kong Institute of Steel Construction

Website: <http://www.hkisc.org/>

ADVANCED STEEL CONSTRUCTION

# ADVANCED STEEL CONSTRUCTION

*an International Journal*

ISSN 1816-112X

Volume 4 Number 2

June 2008

(Special Issue : Steel Space and Composite Structures)



## Editors-in-Chief

*S.L. Chan*, The Hong Kong Polytechnic University, Hong Kong

*W.F. Chen*, University of Hawaii at Manoa, USA

*R. Zandonini*, Trento University, Italy

VOL.4, NO.2 (2008)

## EDITORS-IN-CHIEF

### Asian Pacific, African and organizing Editor

S.L. Chan  
*The Hong Kong Polyt. Univ.,  
Hong Kong*

### American Editor

W.F. Chen  
*Univ. of Hawaii at Manoa, USA*

### European Editor

R. Zandonini  
*Trento Univ., Italy*

## INTERNATIONAL EDITORIAL BOARD

F.G. Albermani  
*The Univ. of Queensland, Australia*

F.S.K. Bijlaard  
*Delft Univ. of Technology, The Netherlands*

R. Bjorhovde  
*The Bjorhovde Group, USA*

M.A. Bradford  
*The Univ. of New South Wales, Australia*

D. Camotim  
*Technical Univ. of Lisbon, Portugal*

C.M. Chan  
*Hong Kong Univ. of Science & Technology,  
Hong Kong*

S.P. Chiew  
*Nanyang Technological Univ., Singapore*

K.F. Chung  
*The Hong Kong Polyt. Univ., Hong Kong*

G.G. Deierlein  
*Stanford Univ., California, USA*

L. Dezi  
*Univ. of Ancona, Italy*

D. Dubina  
*The Politehnica Univ. of Timisoara, Romania*

R. Greiner  
*Technical Univ. of Graz, Austria*

G.W.M. Ho  
*Ove Arup & Partners Hong Kong Ltd.,  
Hong Kong*

B.A. Izzuddin  
*Imperial College of Science, Technology  
and Medicine, UK*

J.P. Jaspart  
*Univ. of Liege, Belgium*

S. A. Jayachandran  
*SERC, CSIR, Chennai, India*

S. Kitipornchai  
*City Univ. of Hong Kong, Hong Kong*

D. Lam  
*Univ. of Leeds, UK*

G.Q. Li  
*Tongji Univ., China*

J.Y.R. Liew  
*National Univ. of Singapore, Singapore*

X. Liu  
*Tsinghua Univ., China*

E.M. Lui  
*Syracuse Univ., USA*

Y.L. Mo  
*Univ. of Houston, USA*

J.P. Muzeau  
*CUST, Clermont Ferrand, France*

D.A. Nethercot  
*Imperial College of Science, Technology  
and Medicine, UK*

D.J. Oehlers  
*The Univ. of Adelaide, Australia*

K. Rasmussen  
*The Univ. of Sydney, Australia*

T.M. Roberts  
*Cardiff Univ., UK*

J.M. Rotter  
*The Univ. of Edinburgh, UK*

C. Scawthorn  
*Scawthorn Porter Associates, USA*

P. Schaumann  
*Univ. of Hannover, Germany*

G.P. Shu  
*Southeast Univ. China*

J.G. Teng  
*The Hong Kong Polyt. Univ., Hong Kong*

G.S. Tong  
*Zhejiang Univ., China*

K.C. Tsai  
*National Taiwan Univ., Taiwan*

C.M. Uang  
*Univ. of California, USA*

B. Uy  
*The Univ. of Wollongong, Australia*

M. Veljkovic  
*Univ. of Lulea, Sweden*

F. Wald  
*Czech Technical Univ. in Prague, Czech*

Y.C. Wang  
*The Univ. of Manchester, UK*

D. White  
*Georgia Institute of Technology, USA*

E. Yamaguchi  
*Kyushu Institute of Technology, Japan*

Y.B. Yang  
*National Taiwan Univ., Taiwan*

B. Young  
*The Univ. of Hong Kong, Hong Kong*

X.L. Zhao  
*Monash Univ., Australia*

## General Information

### *Advanced Steel Construction, an international journal*

#### **Aims and scope**

The International Journal of Advanced Steel Construction provides a platform for the publication and rapid dissemination of original and up-to-date research and technological developments in steel construction, design and analysis. Scope of research papers published in this journal includes but is not limited to theoretical and experimental research on elements, assemblages, systems, material, design philosophy and codification, standards, fabrication, projects of innovative nature and computer techniques. The journal is specifically tailored to channel the exchange of technological know-how between researchers and practitioners. Contributions from all aspects related to the recent developments of advanced steel construction are welcome.

#### **Instructions to authors**

**Submission of the manuscript.** Authors may submit three double-spaced hard copies of manuscripts together with an electronic copy on a diskette or cd-rom in an editable format (MS Word is preferred). Manuscripts should be submitted to the regional editors as follows for arrangement of review.

Asian Pacific, African and organizing editor : Professor S.L. Chan  
American editor : Professor W.F. Chen  
European editor : Professor R. Zandonini

All manuscripts submitted to the journal are highly recommended to accompany with a list of four potential reviewers suggested by the author(s). This list should include the complete name, address, telephone and fax numbers, email address, and at least five keywords that identify the expertise of each reviewer. This scheme will improve the process of review.

#### **Style of manuscript**

**General.** Author(s) should provide full postal and email addresses and fax number for correspondence. The manuscript including abstract, keywords, references, figures and tables should be in English with pages numbered and typed with double line spacing on single side of A4 or letter-sized paper. The front page of the article should contain:

- a) a short title (reflecting the content of the paper);
- b) all the name(s) and postal and email addresses of author(s) specifying the author to whom correspondence and proofs should be sent;
- c) an abstract of 100-200 words; and
- d) 5 to 8 keywords.

The paper must contain an introduction and a conclusion. The length of paper should not exceed 25 journal pages (approximately 15,000 words equivalents).

**Tables and figures.** Tables and figures including photographs should be typed, numbered consecutively in Arabic numerals and with short titles. They should be referred in the text as Figure 1, Table 2, etc. Originally drawn figures and photographs should be provided in a form suitable for photographic reproduction and reduction in the journal.

**Mathematical expressions and units.** The Systeme Internationale (SI) should be followed whenever possible. The numbers identifying the displayed mathematical expression should be referred to in the text as Eq. (1), Eq. (2).

**References.** References to published literature should be referred in the text, in the order of citation with Arabic numerals, by the last name(s) of the author(s) (e.g. Zandonini and Zanon [3]) or if more than three authors (e.g. Zandonini et al. [4]). References should be in English with occasional allowance of 1-2 exceptional references in local languages and reflect the current state-of-technology. Journal titles should be abbreviated in the style of the Word List of Scientific Periodicals. References should be cited in the following style [1, 2, 3].

Journal: [1] Chen, W.F. and Kishi, N., "Semi-rigid Steel Beam-to-column Connections, Data Base and Modelling", Journal of Structural Engineering, ASCE, 1989, Vol. 115, No. 1, pp. 105-119.

Book: [2] Chan, S.L. and Chui, P.P.T., "Non-linear Static and Cyclic Analysis of Semi-rigid Steel Frames", Elsevier Science, 2000.

Proceedings: [3] Zandonini, R. and Zanon, P., "Experimental Analysis of Steel Beams with Semi-rigid Joints", Proceedings of International Conference on Advances in Steel Structures, Hong Kong, 1996, Vol. 1, pp. 356-364.

**Proofs.** Proof will be sent to the corresponding author to correct any typesetting errors. Alternations to the original manuscript at this stage will not be accepted. Proofs should be returned within 48 hours of receipt by Express Mail, Fax or Email.

**Copyright.** Submission of an article to "Advanced Steel Construction" implies that it presents the original and unpublished work, and not under consideration for publication nor published elsewhere. On acceptance of a manuscript submitted, the copyright thereof is transferred to the publisher by the Transfer of Copyright Agreement and upon the acceptance of publication for the papers, the corresponding author must sign the form for Transfer of Copyright.

**Permission.** Quoting from this journal is granted provided that the customary acknowledgement is given to the source.

**Page charge and Reprints.** There will be no page charges if the length of paper is within the limit of 25 journal pages. A total of 30 free offprints will be supplied free of charge to the corresponding author. Purchasing orders for additional offprints can be made on order forms which will be sent to the authors. These instructions can be obtained at the Hong Kong Institute of Steel Construction, Journal website: <http://www.hkisc.org>

The International Journal of Advanced Steel Construction is published quarterly by non-profit making learnt society, The Hong Kong Institute of Steel Construction, c/o Department of Civil & Structural Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong.

**Disclaimer.** No responsibility is assumed for any injury and / or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein.

**Subscription inquiries and change of address.** Address all subscription inquiries and correspondence to Member Records, IJASC. Notify an address change as soon as possible. All communications should include both old and new addresses with zip codes and be accompanied by a mailing label from a recent issue. Allow six weeks for all changes to become effective.

#### **The Hong Kong Institute of Steel Construction**

HKISC

c/o Department of Civil and Structural Engineering,

The Hong Kong Polytechnic University,

Hung Hom, Kowloon, Hong Kong, China.

Tel: 852- 2766 6047 Fax: 852- 2334 6389

Email: [ceslchan@polyu.edu.hk](mailto:ceslchan@polyu.edu.hk) Website: <http://www.hkisc.org/>

ISSN 1816-112X

Copyright © 2008 by:

The Hong Kong Institute of Steel Construction.



ISSN 1816-112X

**EDITORS-IN-CHIEF**

**Asian Pacific, African  
and organizing Editor**

S.L. Chan  
*The Hong Kong Polyt. Univ.,  
Hong Kong*

**American Editor**

W.F. Chen  
*Univ. of Hawaii at Manoa, USA*

**European Editor**

R. Zandonini  
*Trento Univ., Italy*

# Advanced Steel Construction

*an international journal*

---

**VOLUME 4 NUMBER 2**

**JUNE 2008**

---

**Technical Papers (Special Issue)**

- Preface  
*S.P. Chiew*
- A Performance Evaluation of the Arch Bridge Members Using the Strain Index Based on the Parameters Obtained from Linear Buckling Theory 85  
*Sujaritpong Atavit and Toshitaka Yamao*
- Fatigue Strength Characteristics of Welded Stud Joint with Respect to Steel Plate Thickness 103  
*John S.E. Koh, O. Minata and A. Muranaka*
- Aesthetics, Economics and Design of Stainless Steel Structures 113  
*Leroy Gardner*
- Behaviour and Design of Steel-Concrete-Steel-Sandwich Construction 123  
*N. Foundoukos, M. Xie and J.C. Chapman*
- Stress Analysis and Fatigue Test on Partially Overlapped CHS K-Joints 134  
*T. Sopha, T.B.N. Nguyen, S.P. Chiew, C.K. Lee and S.T. Lie*
- Structural Efficiency of Deployable Strut-Tensioned Membrane Structures 147  
*T.C. Tran and J. Y. R. Liew*
- Behaviour and Design of Aluminum Alloy Structural Members 158  
*Ji-Hua Zhu and Ben Young*
- ICASS'09 Conference Announcement

## PREFACE

### **SPECIAL ISSUE ON STEEL SPACE AND COMPOSITE STRUCTURES THE INTERNATIONAL JOURNAL OF ADVANCED STEEL CONSTRUCTION (IJASC SPECIAL ISSUE)**

In 1984, the Singapore Structural Steel Society organized the first inaugural conference on steel and space structures to mark the inception and formation of the Society. Since then, this conference series has always been supported by the SSSS and her sister steel associations from the region. The previous conferences have been held in Singapore and other capital cities, and the 8<sup>th</sup> conference, for the first time, was held in Kuala Lumpur, the capital city of Malaysia.

In addition to our traditional subject areas within steel and space structures, the 8<sup>th</sup> presentation was enlarged to include papers related to composite structures where much developments and applications involving the best usage of steel, concrete and advanced polymer composite materials have taken place in the past decade. Advances in **Steel, Space and Composite structures** are very important due to the potentially huge demand for infrastructural developments and maintenances in this region over the next decade. Steel, space and composite constructions are often adopted in high-rise buildings, long-span bridges and long-span clear roof structures due to its speed and ease of construction, inherent ductility and structural efficiency with large strength-to-weight ratios as well as large flexural rigidities against instability and serviceability problems. It is important to keep abreast with its latest innovations and technical developments to maintain our competitiveness. The conference continue to provide a platform where practising engineers, architects, construction professionals, researchers and scholars can come together and share your common interest in various aspects related to the conception, analysis, design, construction and performance of steel, space and composite structures. In the process, we hope to promote international communication and dissemination of ideas, developments and innovations, and to bridge the gaps between the various parties.

The 8<sup>th</sup> conference proceedings volume covered a wide spectrum of topics and contained more than 65 papers from 25 different countries worldwide. Seven papers were shortlisted for commendable awards and the authors were invited to expand their conference papers for publication in this special issue on steel space and composite structures of the International Journal of Advanced Steel Construction.

Our grateful thanks to Prof S.L. Chan, Chief Editor of the International Journal of Advanced Steel Construction for publishing this special issue.

*Sing-Ping Chiew*

Chairman, Conference Organizing Committee

The Eighth International Conference on Steel, Space and Composite Structures

Kuala Lumpur, Malaysia, 15 -17 May 2006