ADVANCES IN
STEEL STRUCTURES

Proceedings of the
Fourth International Conference on Advances in Steel Structures
13 - 15 June 2005, Shanghai, China

Volume II

Edited by
Z.Y. Shen and G.Q. Li
Tongji University
S.L. Chan
The Hong Kong Polytechnic University

Organized by
College of Civil Engineering, Tongji University
And Department of Civil and Structural Engineering,
The Hong Kong Polytechnic University

Sponsored by
The China Society of Steel Construction
The China Society of Metal Structures for Buildings
The Shanghai Society of Metal Structures

ELSEVIER

Amsterdam • Boston • Heidelberg • London • New York • Oxford
Paris • San Diego • San Francisco • Singapore • Sydney • Tokyo
Preface

International Advisory Committee

Local Advisory Committee

Local Organizing Committee

Fire Resistance

*Recent Improvements on Numerical Methods in Structural Fire Safety
  P. Schaumann, S. Hothan and F. Kettner
  925

*Investigation of Membrane Action in Model Scale Slabs Subject to High Temperatures
  S.J. Foster, I.W. Burgess and R. Plank
  933

*Design Charts for Concrete Insulation of Structural Steel in Fire
  M. B. Wong
  941

*Alternative Approach for Lateral Torsional Buckling of Unrestrained Beams in Fire
  R.B. Dharma and K.H. Tan
  949

*Feasibility of Utilising Catenary Action to Eliminate Fire Protection to Steel Beams
  Y.C. Wang and Y.Z. Yin
  959

*Direct Analysis of Steel and Composite Structures Considering the Effects of Fire
  J.Y.R. Liew, H. X. Yu and R.N. Kleiveland
  965

Strength of Steel/Concrete Composite Beam in Fire
  M.B. Wong and J.I. Ghojel
  973

A Numerical Study of Rotational Capacity of Steel Beams in Fire
  R.B. Dharma and K.H. Tan
  981

Modelling of The Collapse of Large Multi-Storey Steel Frame Structures in Fire
  A.S. Usmani, G.R. Flint, A. Jowsey, S. Lamont, B. Lane and J. Torero
  991

Equivalence Analysis of Thermal and Mechanical Effects on Steel Members under Fire Conditions
  C.K. Chen, R. Yuen, B. Yao and W.C. Fan
  999

Behavior of Steel-Composite Beams Subjected to Fire
  H.Y. Zhou and G.Q. Li
  1005

Experimental Behaviour of Steel Beam to Concrete-Filled Steel Tubular (CFST) Column Connections After Exposure to Fire
  L.H. Han, J.S. Huo and Y.C. Wang
  1011

Calculations on The Fire Resistance of Steel Reinforced Concrete (SRC) Columns
  Y.Q. Zheng and L.H. Han
  1017

* Invited Paper
Stress Concentration Factor (SCF) Test Results of Large-Scale Tubular K-Joints  
*Y.B. Shao, X.G. Zhou and S.T. Lie*  
1127

Influence of Crack Tip Shape on Fracture Behaviour of Components  
*Y.Q. Wang, Y.M. Wu, Y.J. Shi and J.J. Jiang*  
1133

Evaluation of Propagation Considering Elasto-Plastic Behavior at Fatigue Crack Tip  
*Y. Xiong, J. Katsuta, T. Sakiyama and K. Kawano*  
1139

Numerical Study on Fatigue Repair of Structural Steel with Stop Hole Related Techniques  
*Y. Yin and X.L. Liu*  
1145

Extended Finite Element Method for Numerical Simulation of Elastoplastic Fatigue Crack Propagation  
*A. Combescure, T. Elgueidj and A. Gravouil*  
1151

Numerical Modelling of Square Tubular T-Joints with Surface Crack at Corner  
*S.P. Chiew, C.K. Lee, S.T. Lie and H.L. Ji*  
1159

Research on Area Method of The Fatigue Strength Prediction for Welded Steel Structures  
*D.Q. Guan, X.H. Zhao and W.J. Yi*  
1165

The Fatigue Life Curve Prediction Model for Welded Steel Structures Based on Local Method  
*D.Q. Guan and X.H. Zhao*  
1171

**Earthquake Resistance**

*Seismic Performance of Steel Plate Shear Wall Frames  
*K-C. Tsai and Y-C. Lin*  
1179

*Proposal of Improvements for a Simplified Seismic Design of Steel Moment-Resisting Frames  
*J.M. Aribert and H.T. Vu*  
1187

Mitigation of Soft Storey Failures of RC Structures under Earthquake By Encased Steel Profiles  
*A. Plumier, C. Doneux, L. Stoychev and T. Demarcot*  
1193

Antiseismic Analysis of Double-Layer Grid Shell Structures  
*L.J. Li, Z.H. Xie, Y.C. Guo and F. Liu*  
1199

Aseismic Design of Steel Frames Using Hysteretic Energy Demands  
*K.R. Estes and J.C. Anderson*  
1205

Analysis on The Dynamic Stability of Beam String Structures under Earthquake Action  
*C.Y. Ma and Q.H. Han*  
1211

Effect of Geometric Non-Linearity and Displacement Control on The Overall Accuracy of Multi-Directional Pseudo-Dynamic Test  
*M. Obata and Y. Goto*  
1217

* Invited Paper
Hysteretic Performance of Shear Panel Dampers
   Z.Y. Chen, H.B. Ge and T. Usami

Research on Seismic Response Property of Cylindrical Latticed-Intersected-Three-Dimensional-Beam-System Reticulated Mega-Structure with Double Layer Grid Sub-Structures
   Y.J. He, X.H. Zhou, S.L. Dong and J. Li

Numerical Comparison and Optimization of Force and Displacement Based Elements for The Analysis of The Inelastic Cyclic Response of Steel Bracing Members
   A. Agüero, C. Izvernari and R. Tremblay

Seismic Performance Upgrading of Steel Arch Bridges Using Brace Dampers Against Longitudinal Directional Earthquake Motions
   Z.H. Lu, H.B. Ge, K. Hioki, T. Usami and T. Aoki

Seismic Damage Reduction of Steel Moment Resisting Frames Using Post-Tensioning and Friction Dampers
   P. Rojas, J. Ricles and R. Sause

Seismic Response and Design of Stainless Steel Frames
   L. Di Sarno, A.S. Elnashai and D.A. Nethercot

Design

*Comments on Reliability Assessment Methods and Structural Design Codes in the Computer Era
   P. Marek, M. Guštár and V. Krivy

Design of Steel Chimneys
   W. Schneider

Lightweight, Transparent & Dynamic; Special Steel Structures in China
   M. Sarkisian, N. Mathias, A. Mazeika and E. Long

   S.F. Chen

Design of Large-Span Portal Frame System
   M. Cheng, Y.Q. Wang, Y.J. Shi, Y. Zhang and H. Chen

Design and Field Test Research of Large Span and Heavy Load Steel-Concrete Composite Open-Web Floor
   Y. Huang, D.J. Du, X.H. Yang and Y. Jin

Deliberation on Safety Concepts Applied in Design Procedures of Steel Structures
   J. Melcher and Z. Kala

Optimal Design of Open Cross Sections of Cold-Formed Thin-Walled Beams
   K. Magnucki and M. Ostwald

Design of Ma on Shan Indoor Recreation Centre
   M.K. Tong, C.T. Wong and C.C. Choy

* Invited Paper
Study on Application of Staggered Truss System
Y. Yin, F. Huang, N.D. Chu and X.Y. Liu 1323

Optimal Design and Buckling Analysis of a Long-Span Steel Truss
Y. Huang, H. Feng and Y.F. Luo 1329

The Shape Optimization Design of Prestressed Cable-Truss Structure Based on Evolutionary Method of Nodes
A.L. Zhang, H.J. Yang, G.J. Zhang and C.C. Zhang 1335

*Comparison on Structural Systems for Shanghai Jasper Tower
H.C. Jiang, G. Du and Q.Q. Guo 1341

Method for The Design of Light Gauge Steel Frame / Wood Panel Shear Walls
A.E. Branston, F.A. Boudreault and C.A. Rogers 1347

Static Design and Cyclic Behaviour of End-Plate Steel and Composite Joints Strengthened By Haunches
A.Lachal, J.M. Aribert and G. Loho 1353

Influence of Seismic Design Requirements and Building Period on The Design of Low-Rise Steel Buildings
R. Tremblay and C.A. Rogers 1359

Discussion on Structural Scheme Selection of Super Tall Building
S.Z. Lei and Z.Y. Shen 1365

Computations and Structural Analysis

*Numerical Modelling of Tube and Fitting Access Scaffolding Systems
R.G. Beale and M.H.R. Godley 1375

Ultimate Strength of Tapered Steel Plate Girders under Combined Shear and Bending Moment
E. Mirambell and A.V. Zárate 1383

Study on The Regularities of Distribution of Additional Force of Jointless Rails on Bridge
L. Gao, K.M. Yin and C. Peng 1389

Column-to-Column Interaction in Buckling of Frame
G.S. Tong 1395

Shear Buckling Stress in Stainless Steel Plate Girders
L. Estrada, E. Real and E. Mirambell 1403

Behavior of Concrete Filled Rectangular Steel Tubes(CFRST) Subjected to Biaxial Eccentric Compression After High Temperature
S.F. Jiang, M. Li and J.F. Zhang 1409

The SIF Formulae for Some Center Cracked Thin-Walled Members
L. Zhou and Y. Huang 1415

* Invited Paper
The Influence of Column Base Connections on The Stability of Slender Multi-Bay Frame Structures  
H.H. Lau, R.G. Beale and M.H.R. Godley

1421

The Effects of Surrounding Members on Post-Buckling Behavior of Thin Steel Plate Shear Walls (TSPSW)  
M.M. Alinia and M. Dastfan

1427

Ultimate Strength of Stiffened Aluminium Panels Subjected to Axial Compression and Lateral Pressure, Considering HAZ Effects  
Q.F. Chen and T. Moan

1433

Nonlinear Analysis of Angle Trusses  
S. H. Cho and S. L. Chan

1439

Nonlinear Finite Element Analysis on Bending Capacity of Composite Slim Beam with Deep Decking  
Q.Z. Li, Y.J. Shi, Y.Q. Wang and R.H. Zhang

1445

Failure Mechanisms of The Floating Deck Pontoon of an Oil Tank under Concentrated Loads  
T. Hara, M. Katsui and Y. Katsui

1451

Bearing Stress and Buckling of Webs in Crane Runway Girders under Wheel Loading  
T. Ren and G.S. Tong

1457

Structural Behavior of Corrugated Zincalume Thin Shell Metal Elements as a Self-Supporting Roofing Element  
S.M. Zahurul, A.A. Abang-Abdullah and M.S. Jafar

1463

An Equilibrium Approach for Flexural-Torsional Buckling of Elastic Arches  
Y.-L. Pi, M.A. Bradford and Y.Y. Chen

1471

Overall Stability of Long-Span Steel Structure Suspended with Steel Arches  

1477

Split Rigidity Method for Bending and Vibration Analysis of Circular Three-Way Space Grids  
W-F. Zhang and W-Y. Liu

1483

Analysis of Static and Dynamic Behaviors of Pre-Stressed Double Layer Space Grids  
W-F. Zhang and F. Yao

1489

The Effects of The FEM Models on The Dynamic Property and Response Analyses of Transmission Towers  
D.S. Zhao

1495

Application of Vectorial Rotational Variables in Large Displacement Analysis of Structures  
Z.X. Li and B.A. Izzuddin

1501

Practical Advanced Analysis for Steel Structures  
A. Agüero and J. R. Atienza

1507

* Invited Paper
Overall Stability of The Large-Scale Steel Structure of Pudong Institute

Stability Behavior of Column-Supported Steel Silos with Engaged Columns
Y. Zhao and J. Yu

Symmetry Limit Theory for Elastic-Perfectly Plastic Structures in The Alternating Plasticity Region
K. Uetani and M. Kobayashi

Constructional Steel

Effects of Elevated Temperatures on Mechanical Properties of Stainless Steel
J. Chen and B. Young

Analytical Bond Models Between Steel and Normal Modulus CFRP
H.B. Liu, X.L. Zhao, R. Al-Mahaidi and S. Rizkalla

Lateral Torsional Buckling of Rafters in Tank Structures and The Stabilizing Influence of The Roof
A. Hübner, H. Saal and S. Holzer

The Effects of Groove Design on Residual Stress Distribution
L.W. Jia and H.B. Zhou

Dynamic Analysis of Soil-Structure Interaction of High-Rise Steel Staggered Truss System
J.G. Jiang, X.H. Zhou and J.S. Zhang

Extra High Strength Steel Plasticity-Experimental Work and Constitutive Modelling
J. Gozzi and A. Olsson

Residual Stresses in Square Hollow Sections Made of High Strength Steel
M. Clarin and O. Lagerqvist

Double Strap Joint Tests to Determine The Bond Characteristics Between CFRP and Steel Plates
S. Fawzia, X.L. Zhao, R. Al-Mahaidi and S. Rizkalla

Status and Trends in The Development of Steels Used in Some Important Steel Structures
L.R. Chen

Required Metallurgical Characteristics of Steel for Advanced Steel Intensive Structures
R.K.P. Singh

Durability of Bluescope Lysaght Steel Framing System
Campbell J. Seccombe

Study on Unified Constitutive Relationship of Bondslip Between Steel and Concrete in SRC Structure
S.S. Zheng and G.Z. Deng

* Invited Paper
Bridges

*Non-Periodic Spline Finite Strip Analysis for Steel Bridge
   K.-H. Kim, C.-K. Choi and C.-M. Jung

Effect of Rubber Bearing Ageing on Seismic Response of Base-Isolated Steel Bridges
   H.S. Gu, Y. Itoh and K. Satoh

The Design and Experimental Study of the Steel-Concrete Composite Box Girder of a
Harp-Shaped Single Span Cable-Stayed Bridge
   H. Zhao, X.D Shao, J.J. Qin, L.F. Li and W.H. Peng

Design and Stability Analysis of a Special Concrete-Filled Steel Tabular Arch Bridge
   G.X. Ning, P.Z. Lin and Y.L. Zhao

Design of Main Girder of a Harp Shaped Cable-Stayed Bridge
   W.H. Peng, X.D. Shao and L.F. Li

Safety Assessment of Existing Riveted Railway Bridges
   C.S. Wang, A.R. Chen, W.Z. Chen and J.G. Nie

Loading-Behavior Tracing of an Auxiliary Steel Structure Used for a Long-Span Arch Bridge
Construction
   Y.F. Luo, H.B. Qiu and C. Su

Research and Scale Model Test on the Local Stability of Steel Box Arch Segment of Lupu
Bridge
   F. Yue

An Acceleration-Cyclic Corrosion Test of Coating Systems for Steel Bridges
   I.-T. Kim and Y. Itoh

Influence of Damping Change on Dynamic Response of Concrete-Filled Steel Tubular Arch
Bridges
   J. Wen and Y.F. Wang

Seismic Retrofitting Highway Truss Bridges
   C. Seim, P. Yen and J.S. O'Connor

Wind Resistance

The Buckling of Thin-Walled Cylinder under Wind-Loading- an Experimental Study
   M. Pircher, B. Lechner and H. Trutnovsky

Wind Load and Wind-Resistant Analysis Methods for Large Cantilever Planar Canopy
Structures
   Y.Q. Li, Y. Tamura, Z.Y. Shen and A. Katsumura

The Wind-Induced Vibration Comfort Analysis of Wuhan International Securities Mansion
   H. Chen, Y.Q. Wang, Y.J. Shi and S.Q. Wen

Mean Wind Pressure Coefficients on Gable Roof of Low-Rise Buildings
   Y. Quan, Y. Tamura, M. Matsui and A. Yoshida

* Invited Paper
Vibration

*LSFD Method for Vibration Analysis of Plates with Free Edges
  C.M. Wang, W.X. Wu, C. Shu and T. Utsunomiya 1715

Vibration Evaluation of Lightweight Floors Supported by Cold-Formed Steel Joists
  L. Xu 1723

Dynamic Response Analysis for Truss Cable Structures
  W.F. Zhang and Y.C. Liu 1731

Improvement of Dynamic Property of Raft Structure in Vibration Isolation System Through Sensitivity Analysis
  G.Z. Wang and X.G. Zheng 1737

Dynamic Stability Analysis and Vibration Control Study of Tensioned Cable-Truss Structures
  M.H. Wang and Q.S. Yang 1743

Damage Detection of a Cracked Column Via a Neural Network Approach
  J-D. Yau 1749

Wind Tunnel Tests and Wind-Induced Vibration Analysis on Spherical Domes
  Z.H. Zhang, Y. Tamura, M. Matsui and Y. Tomoya 1755

Research on Damping Isolation to Reduce Vibration and Effectiveness Analysis of Vibration Control for Steel Offshore Platform
  Y.S. Yu and Y. Wang 1761

The Dynamic Characteristic of Complex Form Cable-Truss Supporting System
  D.X. Gao, S.L. Yang and Y.L. Hang 1767

Late Papers

3D Finite Element Prediction of Angle Bolted Connection with High Strength Steel
  S. Taufix and R.Y. Xiao 1775

Characteristics of Wind Load and Wind Resistant Design of membrane Structure Canopy Roof of Large-Scale Stadium
  J.M. Ding and Z.J. He 1783

Accurate Determination of the Plastic Collapse Loads of Shells When Using Finite Element Analyses
  J.M.F.G. Holst, C. Doerich and J.M. Rotter 1789

Fatigue Life Prediction of Out-Of-Plane Gusset Welded Joints with Curvatures
  D.H. Choi, H.Y. Choi and H. Yoo 1795

Uplift Tests on Column Base Plate Connections
  T. Wilkinson, A. Daniels, M. Wilton and D. Wood 1801

* Invited Paper
Tests to Examine the Effect of Axial Compression on the Rotation Capacity of Square Hollow Sections

T. Wilkinson and R. Jouaux

Late Keynote Papers

Stability and Plasticity in Structural Analysis: A New Conceptual Framework

J.M. Rotter

Utilization of High Performance Steels in Urban Structures

K. Takanashi, M. Aburakawa and H. Hamaguchi

Index of Contributors

Keyword Index

* Invited Paper