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The primary aims of the Centre are:

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b) To facilitate the transfer of these technologies to the construction industry through specialist consultancies, technical and professional publications, conferences and seminars, and continuing professional development training courses.

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http://www.cse.polyu.edu.hk/research/rcatise/home.htm

The Hong Kong Institute of Steel Construction (HKISC) was established in November 2000. It is registered as a non-profit making organization with its board members from universities, consultants, contractors and regulatory agents in Hong Kong.

The HKISC serves the steel construction industry in Hong Kong and the region with the following missions:

a) Channeling of technology transfer between academic and industry for improved quality in design, analysis and construction;

b) Organizing seminars for local and overseas experts for dissemination of their latest technological know-how;

c) Organizing international conferences for sharing of expertise between local and overseas researchers and engineers;

d) Steering university researches to be more practical and useful for practitioners;

e) Disseminating new technology worldwide among members; and

f) Developing and fostering friendship among members.

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Advances in Steel and Composite Structures are important to practicing engineers in Hong Kong due to the potentially huge demand for infrastructure in Hong Kong and China over the next decade. Steel and composite construction is very often adopted in super high-rise buildings, and long span bridges and roof structures owing to high structural efficiency with large strength-to-self-weight ratios as well as large flexural rigidities against instability and serviceability problems. It is important for design and construction engineers in Hong Kong to keep abreast of the latest technological developments in steel and composite construction to maintain their competitiveness in the region.

With the strong support of the local construction industry in Hong Kong, this International Symposium provides a technical forum for the dissemination of recent advances in steel and composite construction technology. A total of eight renowned academics and researchers have been invited to present the findings of their research work as well as to share their experiences to over 100 engineers from government departments, consultant firms and construction companies in Hong Kong and Southern China.

We are grateful for the support rendered by the Hong Kong Institute of Steel Construction, and also to all the sponsors to this Symposium as well as their continual contributions in promoting steel and composite construction technology in the Region.

Professor K F Chung
Chairman
Organizing Committee
The International Symposium on Advances in Steel and Composite Structures 2005
## International Symposium on Advances in Steel and Composite Structures 2005

**Organized by**
Department of Civil and Structural Engineering, The Hong Kong Polytechnic University

**Supported by**
The Hong Kong Institute of Steel Construction

**Sponsored by**
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**Friday 2 December 2005**

Senate Room (Room M1603), Li Ka Shing Tower, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

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<td><strong>Ir Professor J M Ko</strong> Vice President, The Hong Kong Polytechnic University, Hong Kong SAR</td>
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<td><strong>Ir Dr Greg Wong</strong> President, The Hong Kong Institution of Engineers</td>
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<td><strong>Professor Mark A Bradford</strong> The University of New South Wales, Sydney, Australia</td>
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<td><strong>Professor S P Chiew</strong> Nanyang Technological University, Singapore</td>
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<td><strong>Professor L H Han</strong> Tsinghua University, Beijing, China</td>
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DUCTILITY AND STRENGTH OF COMPOSITE T-BEAMS
WITH TRAPEZOIDAL SLABS

M. A. Bradford
School of Civil and Environmental Engineering
The University of New South Wales, Sydney, NSW 2052, Australia

ABSTRACT

Composite T-beams with slabs cast onto profiled steel sheeting with through-welded stud shear connectors are an economical form of composite construction. Recently, deep trapezoidal slabs have become popular in several countries, but there is some disquiet amongst practising engineers regarding the robustness of the shear connection, and in particular to demonstration of its ductility. This paper presents an experimental study both of push-tests and of full-scale beam tests in composite T-beams with trapezoidal sheeting, in which the ribs of the sheeting are orthogonal to the longitudinal axis of the steel joist. It is argued that the transfer of forces in conventional push-tests does not replicate the situation that occurs in full-scale beams subjected to flexure, and because of this a modified push-testing procedure is proposed and described. This push-test apparatus is able to eliminate premature brittle failure modes that do not occur in real flexural members, so that the performance of the shear connection in a real beam can be predicted based on these push-test results. Two full-scale tests on 8 metre span beams are then described. It is shown that the full-scale beams display the highly ductile response that was predicted by the push-testing procedure. The members considered in this investigation were reinforced only with conventional reinforcement needed for shrinkage, fire and one-way slab bending.
NOVEL SANDWICH COMPOSITE STRUCTURES

J. Y. Richard Liew\textsuperscript{1} and T. Y. Wang

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Blk E1A #05-13, 1 Engineering Drive 2, Singapore 117576
\textsuperscript{1}Email: cveljy@nus.edu.sg; Fax: +65-67791635

ABSTRACT

Sandwich composite structure is gaining ground in wide scopes of applications. If a structure is potentially subjected to significant bending moment, cyclic loading and potential large impact loading, it will find steel-concrete-steel sandwich system as an appealing alternative. This paper describes a novel sandwich composite structures which can be utilized in the civil and offshore engineering. Various aspects including the structural behavior under impact loading, shear connectors, and interfacial bonding strength between steel face plate and concrete core have been studied.
RECENT DEVELOPMENTS ON COMPOSITE SLAB CONSTRUCTION USING PROFILED STEEL DECKINGS

K. F. Chung and A. J. Wang

Department of Civil and Structural Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, PR China.

Abstract

This paper reviews recent developments on composite slab construction, and a codified fire resistant design method is presented which is widely used to assess the structural performance of composite slabs using profiled steel deckings in fire. The performance based design method consists of two analyses: a) Thermal Analysis, and b) Strength Analysis; details of the two analyses are fully presented. The proposed design method enables rational analyses on composite slabs using conventional profiled steel deckings of proven configurations as well as innovative profiled steel deckings with modified configurations. Design and construction engineers are, thus, encouraged to take advantages offered in the proposed structural fire engineering method to build steel and composite structures with large inherent fire resistances.
ADVANCED STATIC/DYNAMIC, ELASTO-PLASTIC AND FINITE DISPLACEMENT ANALYSIS OF STEEL AND COMPOSITE SPATIAL STRUCTURES

T. Kitada¹, M. Matsumura¹, Y. R. An¹ and T. Yamano²

¹Department of Civil Engineering, Osaka City University, 3-3-138 Sugimoto, Sumiyashi-ku, Osaka, 558-8585 Japan
²Institute of System and Technology, JIP Techno Science Corporation, 93 Chudoji Awata-cho, Shimogyo-ku, Kyoto, 600-8815 Japan

ABSTRACT

This paper describes the outline of the advanced computer program, EPASS/USSP for introducing how to analyze the static or dynamic, elasto-plastic and finite displacement behavior of steel or steel-concrete composite spatial structures. EPASS/USSP has been developed by authors and their coworkers in Osaka City University and JIP Techno Science Corporation. The program consists of two sub-programs, EPASS and USSP. EPASS is the program on the basis of FEM for analyzing the static or dynamic, elasto-plastic and finite displacement behavior of steel, steel-concrete composite and reinforced concrete spatial framed structures with residual stress and initial imperfections. USSP is the program also on the basis of FEM for analyzing the static or dynamic, elasto-plastic and finite displacement behavior of steel plated structures and solid concrete structures with residual stress and initial imperfections. The contents of this paper are the fundamental theories adopted in developing EPASS and USSP, available finite elements, and practical examples which EPASS, USSP and EPASS/USSP are used as follows:

(1) Researches on the ultimate strength of steel plated structures, and steel framed bridge structures and seismic retrofitting of steel bridge piers.

Described briefly in this paper also are the issues to be solved and points to be developed in this program for the sustainable future development.
ADVANCED ANALYSIS FOR DESIGN OF SEMI-RIGID JOINTED ANGLE TRUSSES

S.L. Chan¹ and S.H. Cho

Department of Civil and Structural Engineering,
The Hong Kong Polytechnic University, Hong Kong SAR
¹email: ceslchan@polyu.edu.hk; Fax: (852) 2334 6389

ABSTRACT
Advanced analysis and the second-order elastic and plastic analysis have been used in numerous projects in Hong Kong, Macau, Taiwan and China and the advantages in safety, efficiency and economical design have been manifested. These applications, however, are mostly limited to doubly symmetrical sections like hollow and I-sections and the use of the method to angle sections is limited. This paper studies the method of advanced analysis used on the design of angle trusses. Comparison with BS5950(2000) is also given. Findings show that the use of initially crooked element with imperfection provided in the Table 6.1 or the Hong Kong Steel Code can provide a reliable design against the ultimate limit state design of this structural form.
SOME KEY ASPECTS OF BS5950 STEEL CONNECTION DESIGN

Chiew Sing-Ping
School of Civil and Environmental Engineering
Nanyang Technological University, Singapore

ABSTRACT

The implementation of the BS5950-1: 2000 version marks a major milestone in the development of the prevalent steel design code as it is a major revamp from the earlier 1990 version. Besides revamping the format in which the design rules are being presented, some new design concepts are introduced as a result of the calibration study on Eurocode 3. These changes will eventually pave the way for engineers to switch over to Eurocode 3 which is due to replace the national steel design codes in many Western European countries by the end of this decade. With each major revamp, code users are expected to be familiar with basic steel design and specific design concepts in the previous version. However, this is often not the case and mistakes continue to be made when using the revised version. This paper highlights four such design cases involving strut-waler connection, tubular joint, stiffener and end-post design and column web panel under shear. These four cases all focus on steel connection design aspects and worked examples are used to exemplify and illustrate the consequences of such design errors.
CONCRETE-FILLED TUBULAR CONSTRUCTION

X. L. Zhao

Department of Civil Engineering, Monash University
Clayton, VIC 3800, Australia

ABSTRACT

This paper presents the recent development and design of concrete-filled tubular construction. It starts with a brief description of the advantages and challenges of using such composite construction. Resources related to the design of concrete-filled tubular construction are listed. The design of concrete-filled tubular members in bending, compression and combined actions is presented. The difference in designing concrete-filled tubes (CFT) and unfilled tubular members is emphasized. The paper also presents the fire resistance of CFT columns including the use of high strength concrete. The principles in earthquake design are pointed out. Discussions are also made on concrete-filled double skin tubes (CFDST).
SOME NEW DEVELOPMENTS IN CONCRETE-FILLED
STEEL TUBULAR STRUCTURES
IN THE MAINLAND CHINA

Lin-Hai Han¹,²

¹ Department of Civil Engineering, Tsinghua University, Beijing, 100084
People’s Republic of China
² Key Laboratory of Structural Engineering and Vibration of China Education Ministry,
Tsinghua University, Beijing, 100084, China

ABSTRACT

This paper summarizes some of the research work on concrete-filled steel tubes (CFST) from
the mainland, China, with an emphasis on concrete-filled columns and beam-columns. The
topics covered include: 1) Beam-columns subjected to static loading; 2) Beam-columns
subjected to cyclic loading; 3) Long-term load effects; 4) Fire resistance; 5) Residual strength
after exposure to fire; 6) Effects of pre-stress in steel tube on the composite columns; 7)
Effects of concrete compaction; 8) High performance concrete-filled steel tubular columns,
and 9) Concrete-filled double-skin steel tubes. A few practical projects with concrete-filled
steel tubes used in the mainland of China are also introduced.
BIOGRAPHY OF SPEAKERS

Professor Mark A Bradford
The University of New South Wales, Sydney, Australia

Mark Bradford is a Scientia Professor and Professor of Civil Engineering at the University of New South Wales. He currently holds an Australian Government Federation Fellowship undertaking research into steel and composite steel-concrete structures, in particular when subjected to elevated temperatures. Professor Bradford has some 25 years experience in the research of structural engineering and in engineering mechanics, and has published several textbooks as well as numerous journal articles and conference papers in this broad area. He also serves on the editorial boards of over ten journals, and is a member of the Standards Australia code committees on steel structures and on composite construction. He provides expert consultancy to industry.

Professor J Y Richard Liew
National University of Singapore, Singapore

Prof. Liew is currently an Associate Professor of the Department of Civil Engineering, National University of Singapore, and he is also Immediate Past President of Singapore Structural Steel Society. He has authored three books and published more than 150 technical papers and book chapters related to stability analysis and design of frame structures, composite structures and lightweight space frame systems. He is a Chartered Engineer, a Member of the Institution of Structural Engineers, U.K. and a Professional Engineer in Singapore. He has extensive experience on large-span roof systems, multi-storey steel and composite buildings and fire resistance design of structures. He is a Member-at-Large of the Structural Stability Research Council, USA.

Professor K F Chung
The Hong Kong Polytechnic University, Hong Kong SAR

Prof. K. F. Chung is a chartered structural engineer with established expertise in steel and composite design and construction in both UK and Hong Kong. He has published extensively on steel and composite construction in both research and professional journals including over 100 journal and conference papers and five SCI Design Guides on advanced steel and composite construction technology. Prof. Chung is also active in services to professional communities and serves both the Hong Kong Institution of Engineers and the Hong Kong Institution of Steel Construction in various capacities. He is a frequent speaker in various professional seminars and technical conferences.

Professor T Kitada
Osaka City University, Osaka, Japan

Prof. Kitada is currently a Professor of Bridge Engineering Laboratory in the Department of Civil Engineering, Osaka City University, and he is also Vice President of Kansai Branch of Japan Society of Civil Engineering. His research interests include:
- Buckling and ultimate strength of spatial bridge structures
- Seismic design and seismic retrofitting of bridge structures
- Development of computer programs of static/dynamic, elasto-plastic and finite displacement analysis of spatial bridges
- Vibration characteristics and control of marker frames and lighting poles on highway bridges
Professor S L Chan
The Hong Kong Polytechnic University, Hong Kong SAR

Professor S. L. Chan is now with the Department of Civil and Structural Engineering of the Hong Kong Polytechnic University. Currently he is the chief editor of the Advanced Steel Construction, an International Journal and the Asian regional editor of International Journal of Applied Mechanics and Engineering. He also serves as a member of editorial boards in 4 other journals, of ad-hoc committees in drafting guides for design of steel and glass structures in Hong Kong and of glass structures for the IStructE, of which he is also a member of the Research Panel. Currently he is the President of the Hong Kong Institute of Steel Construction for promotion of technology in steel related construction. His research interests include the stability analysis and design of steel, glass and slender skeletal structures, scaffolding and pre-tensioned steel structures.

Professor S P Chiew
Nanyang Technological University, Singapore

Prof. Chiew is an Associate-Professor in the School of Civil and Environmental Engineering, Nanyang Technological University, Singapore and a Past President of the Singapore Structural Steel Society. He is also currently serving as a Council Member of the Institution of Engineers, Singapore and Vice-Chairman of the Singapore Division of the Institution of Structural Engineers, UK. He has acted as consultant to external organizations; recently appointed as Expert Advisor of the Land Transport Authority of Singapore. His major areas of interest are structural stability, tubular construction, steel and composite structures, and he has published over 80 technical papers in various journals and conferences. He has also authored a book on structural steelwork design and edited 3 steel conference proceedings. He received the Merit and Distinguished Awards from the National Standards Council of Singapore in 1995 and 1997 respectively in recognition of his contribution to Singapore’s national standardization programme.

Professor X L Zhao
Monash University, Melbourne, Australia

Prof. Xiao-Ling Zhao received his PhD from The University of Sydney in 1993. He is holding the Chair of Structural Engineering at Monash University, Australia. His research interests include tubular structures, thin-walled structures and CFRP strengthening of steel structures. Prof. Zhao received the 1995 Engineering Excellence Award from the Institution of Engineers, Australia - Sydney Division. He was awarded the Alexander von Humboldt Fellowship in Germany in 1997 and the JSPS (Japan Society for the Promotion of Science) Invitation Fellowship (long-term) in 2002. He received the H.K. Cheng Structural Engineering Fellowship (Hong Kong) in June 2005. He was a visiting professor at ICOM, EPFL - Lausanne from July to August 2005. Prof. Zhao is a member of the Editorial Board for Thin-Walled Structures and International Journal of Structural Stability and Dynamics. He is a Fellow of Institution of Engineers, Australia. Prof. Zhao chairs the IIW (International Institute of Welding) sub-commission XV-E on Tubular Structures.

Professor L H Han
Tsinghua University, Beijing, China

Prof. Lin-Hai Han is a professor in structural engineering in Tsinghua University, China. He has a strong research background in steel-concrete composite structures. He has published more than 50 journal papers and has written three books on steel-concrete composite structures in recent ten years. He has been the writers of several design codes on steel-concrete composite structures in China.

Prof. Han is currently working in the field of composite structures under various loads, such as static, dynamic, fire, post-fire and etc.
ACKNOWLEDGEMENTS

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