



FEATURE STORY

Visit of PolyU Senior Management

The Senior Management of PolyU comprised of the following delegates visited the Structural Engineering Research Laboratory on 7 February 2023:

- Prof. J. G. Teng, President
- Prof. W. T. Wong, Deputy President & Provost
- Dr. Miranda Lou, Executive Vice President
- Prof. Christopher Chao, Vice President (*Research & Innovation*)
- Prof. Ben Young, Vice President (*Student & Global Affairs*)

Prof. C. S. Poon, Head of Department of Civil and Environmental Engineering (CEE), and Prof. K. F. Chung, Director of CNERC received them at the Laboratory while Dr. T. M. Chan, Laboratory-in-charge introduced various research projects on modern steel construction technology to the Senior Management.



Moreover, Prof. J. M. Ko, Emeritus Professor (Structural Engineering) and Prof. X. D. Li, Dean of FCE, PolyU visited CNERC on 24 February 2023. Prof. K. F. Chung, Director of CNERC and Prof. Michael Yam, Deputy Director of CNERC received them and reported the progress and research development of CNERC.



AWARDS

Double Grand Awards – CNERC’s research excellence in high strength S690 steel construction technology

On 10 February 2023, our research project entitled “*Basic Theory, Key Technology and International Application of Chinese High Strength 690MPa Steel Structures*” received a Grand Award of the China Steel Construction Society (CSCS) Science and Technology Awards 2022 (Cert. No. 0163 of National Office for Science and Technology Awards (www.nosta.gov.cn)). For details: https://www.polyu.edu.hk/cnerc-steel/images/news_events/newsletter/issue202302-en.pdf



Prof. Chung (centre) received the Grand Award of the CSCS Science and Technology Awards presented by Academician Q.R. Yue and Academician X.H. Zhou at the Opening Ceremony of the CSCS Annual Conference

Moreover, on 9 March 2023, we were honored to receive the Grand Prize on Innovative Application of The HKIE Grand Award 2023 for our research work entitled “*Innovative construction technology and application of high strength S690 steel in construction*”. For details: https://www.polyu.edu.hk/cnerc-steel/images/news_events/newsletter/issue202303-sp-en.pdf



The Grand Award was presented by
The Honourable Winnie Ho, JP, Secretary for Housing of the Government of Hong Kong SAR (left four),
and
Ir Aaron Bok, President of the Hong Kong Institution of Engineers (right four)

NEWS

Technical Publications on High Strength Steel

The Steel Construction Institute (SCI) (www.steel-sci.com) in the U.K. is a trusted, independent source of information and engineering expertise globally for over 30 years, and it has produced high quality and reliable technical reports and publications which are used as definitive guidance within the sector on the effective use of steel in construction. Moreover, SCI is one of the official members of Technical Committee on development of Structural Eurocode EN 1993.

CNERC and SCI have long years of working relationship since 2017 on high strength S690 steel, and their use under Structural Eurocodes. As a result of technical collaboration, the following documents have been compiled:

- **High strength steel structures: A summary of research carried out at CNERC from 2015 to 2021. SCI-RT 1907: 2022** *(in both English and Chinese)*

This document presents key findings of selected CNERC research projects conducted from 2015 to 2021 under the work theme of promoting effective use of high strength S690 steel in construction. Both experimental and numerical investigations into mechanical properties and structural behaviour of high strength S690 steel members, connections and joints are summarized.

- **High strength steel structures: A review of international research and design recommendations. SCI-RT 1908: 2022**

This document presents comparative studies on key findings on selected CNERC research projects conducted from 2015 to 2021 on high strength S690 steel with other research projects available in the literature. Critical reviews on test data, design methodology and numerical modelling techniques are reported.


- **High strength steel structures: Design and construction using high strength steel in China. SCI-RT 1925: 2023** *(in both English and Chinese)*

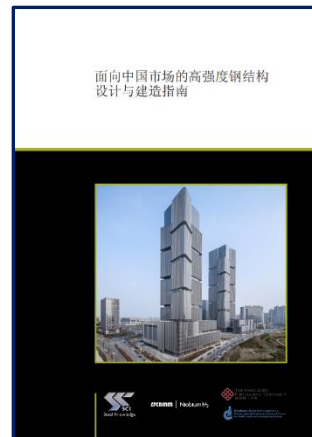
This document provides specific guidance to design and construction engineers in using high strength steel from S420 up to S700 with a special emphasis on practice of the Chinese steel construction. Design examples are also provided to assist engineers to go through the design process.



High strength steel structures:
A summary of research carried out at CNERC from 2015 to 2021

Report to: CNERC
 Evidence: 07-1907
 Version: 34
 Date: 10 November 2022





Please go to the CNERC website via the following link for free downloadable documents:
<https://www.polyu.edu.hk/cnerc-steel/en/publications/publication/>

For other CNERC Publications, please check out our website at:
<https://www.polyu.edu.hk/cnerc-steel/en/publications/publication/>

NEWS

Construction Industry Council Construction Talk: Webinar on Effective Design and Construction of High Strength S690 Steel

On 6 February 2023, Ir Prof. K. F. Chung, Director of CNERC, and Ir Dr. H. C. Ho, Deputy Executive Secretary of the CNERC, were invited to present for the CIC Webinar on the topic of “**Effective Design and Construction of High Strength S690 Steel**”, and shared their experience on advantages, design development, codification and applications of high strength S690 steel.

Presentations:

Innovative construction technology and application of high strength S690 steel in construction

by Ir Professor K. F. Chung

Design and construction of high strength S690 steel in civil engineering projects – *Design & Practical issues*

by Ir Dr. H. C. Ho



Webinar on Effective Design and Construction of High Strength S690 Steel

Monday, February 6th 2023 - 5:00 PM (CST)

During the presentation, Prof. Chung and Dr. Ho shared key research findings on mechanical properties of high strength S690 steel and their welded sections, as well as their structural behaviour conducted at the CNERC between 2015 and 2021. Recent design development and codification of these steel in Hong Kong and Europe, and their applications in various types of structural systems were also reported. The webinar was attended by about 1,300 engineers and professionals.

NEWS

Technical Seminars on Efficient Design and Application of High Strength S690 Steel

On 7 February 2023, Ir Prof. K. F. Chung, Director of CNERC, Ir Dr. H. C. Ho, Deputy Executive Secretary of the CNERC, and Dr. Y. F. Hu, Research Assistant Professor were invited as principal speakers in the Technical Seminar entitled “*Efficient Design and Application of High Strength S690 Steel*”. Over a period of three hours, they shared their experience on structural advantages, design development and codification as well as applications of high strength S690 steel at the Headquarter of Housing Authority in Ho Man Tin.

The Technical Seminar was hosted by Ir. P. Y. Wong, Structural Engineer of Housing Department. About 70 engineers and architects attended the seminar, and many of them participated actively with questions and discussions on various technical areas.



Contents:

- a) Key research findings on S690 steel
- b) Structural behaviour of S690 welded H-sections and tubular sections
- c) Design development and codification of S690 steel
- d) Potential applications of S690 steel in various types of structural systems
- e) Practical issues on design and construction associated with S690 steel

On 20 February 2023, Ir Prof. K. F. Chung, Director of CNERC, Ir Dr. H. C. Ho, Deputy Executive Secretary of CNERC, and Dr. Y. F. Hu, Research Assistant Professor were invited as principal speakers in the Technical Seminar entitled “*Efficient Design and Construction of High Strength S690 Steel*”. Over a period of three hours, they shared their experience on various practical issues on design and construction of high strength S690 steel at the Buildings Department Headquarters in the West Kowloon Government Offices. There were about 100 technical and professional staff who attended the seminar.

Contents:

- a) Welding of S690 steel, and pre-heating and post-welding treatment
- b) Welding procedures specifications, and welding approval tests
- c) Non-destructive inspection on welded sections
- d) Supply of high quality S690 from China
- e) Potential applications of S690 steel in various types of structural systems

NEWS

HKIE Structural Division Annual Seminar 2023

Prof. K. F. Chung, Director of CNERC gave a presentation on “Effective use of high strength S690 steel in construction” at the Structural Division Annual Seminar 2023 of The Hong Kong Institution of Engineers on 6 March 2023.



NEWS

China Cold-Formed Steel Industry Development Summit 2023

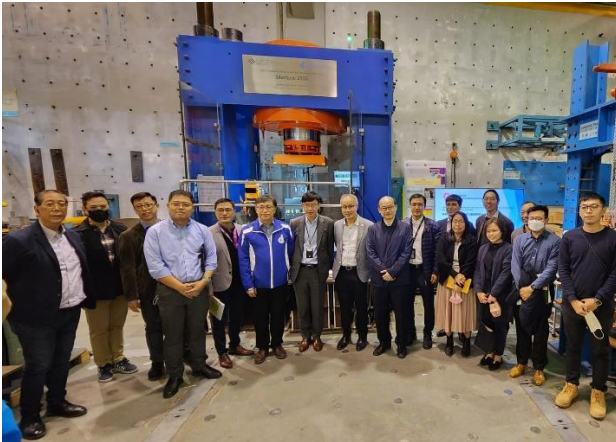
On 23 March 2023, Dr. H. C. Ho, Deputy Executive Secretary of CNERC represented Chinese National Engineering Research Centre for Steel Construction (Hong Kong Branch) to attend the "China Cold-Formed Steel Industry Development Summit 2023" held by the Cold-Formed Steel Branch of the China Steel Construction Association in Suzhou, and attended the 8th meeting of the 4th Executive and Expert Working Group of the Cold-Formed Steel Branch.



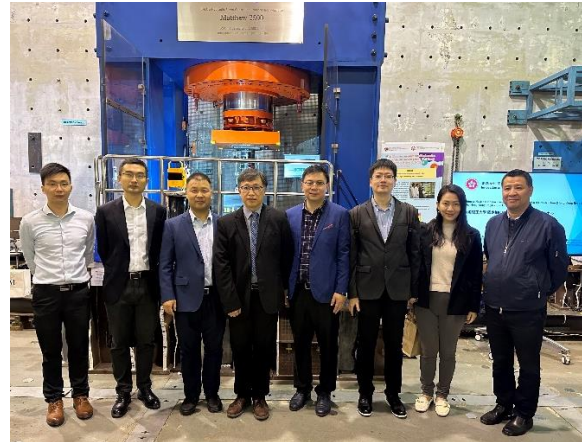
Group photo of the Summit

During the working group meeting, the Cold-Formed Steel Branch of the China Steel Construction Association appointed Prof. K. F. Chung, Director of CNERC and Dr. H. C. Ho as the Deputy Leader and Member of the Expert Working Group of the Branch respectively.

VISITS



A group of engineers led by Civil Engineering and Development Department (North Development Office) together with their guests from AECOM and Chun Wo visited CNERC on 27 February 2023.



Mr. J. Du, Director of Zhejiang Communications Investment Group Co. Ltd. (HK Office) led his team and visited CNERC on 28 February 2023.



Mr. C. C. Choy, Assistant Director of Architectural Services Department, visited CNERC on 22 March 2023.



Prof. K. F. Chung, Director of CNERC visited Ms. X. Y. Sun, Chairman of Steel Structures Division, and Deputy General Secretary of China Constructional Metal Structures Association in Beijing on 28 March 2023.

CNERC RESEARCH

The CNERC Newsletter incorporates research articles from our researchers in aim to share the latest findings in their research work. Should there be any question or comment in these research works, you may send an email to: cnerc.steel@polyu.edu.hk or contact the researchers directly.

The researchers' contact information is available right at the end of each article.

RESEARCH

Advanced “Thermo-Mechanical-Metallurgical” simulation on welding of high strength steel

During welding of high strength steel, an introduction of heat energy may initiate phase change, and undergo complex phase transformation under different cooling rates. These processes cannot be described satisfactorily with conventional thermo-mechanical simulation methods. Therefore, an advanced “**Thermo-Mechanical-Metallurgical**” simulation approach is proposed, and the simulation approach is illustrated in Fig. 1.

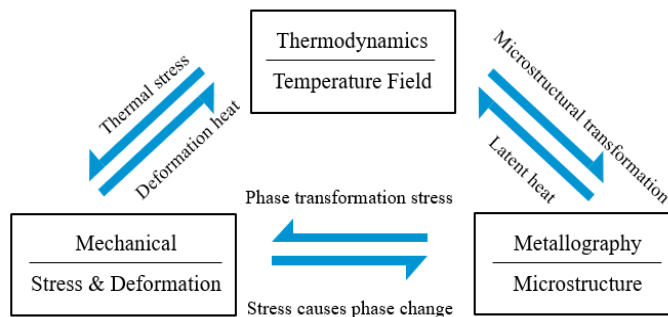


Fig. 1 Thermo-mechanical-metallurgical simulation approach for high strength steel

These three areas are interdependent, and hence, any change in one area will affect the other two areas. For example, a high heat input energy during welding may initiate *phase change and recrystallization*. This leads to changes in *microstructures and their mechanical properties* accordingly, and also their *residual stresses and strains*.

Based on the results of a series of monotonic tensile tests and dilatometry tests, rational material models for high strength steel were developed in the FEM software SYSWELD. Numerical results show that the material models were able to work well in this simulation approach, and temperature changes and phase transformation due to welding were predicted with a high degree of accuracy. Typical predicted temperature distribution of a welded H-section during welding is shown in Fig. 2.

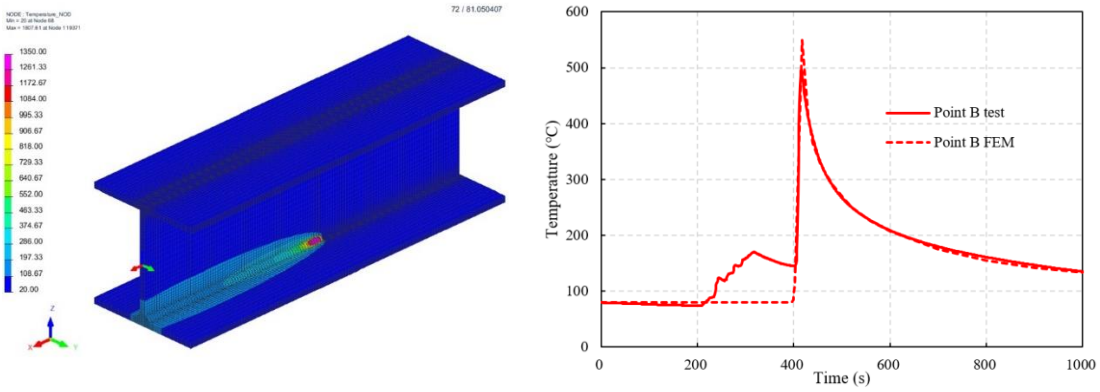


Fig. 2 Numerical results of transient surface temperature distribution of a S960 welded H-section during welding

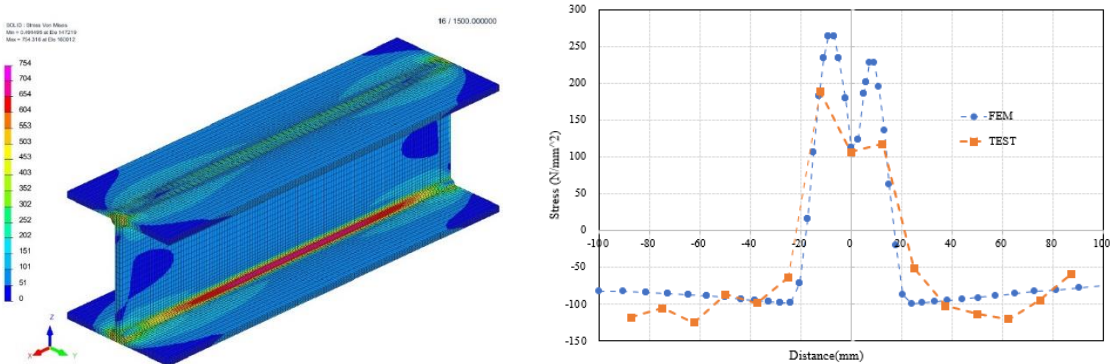
A comparison on the predicted and the observed heat affected zones (after etching) of the welded H-section is illustrated in Fig. 3.



a) Predicted results after phase change and recrystallization and c) Observed HAZ after etching

Fig. 3 Numerical results of metallurgical analysis of the S960 welded H-section after welding

The predicted residual stresses of the welded H-section after thermo-mechanical analysis is illustrated in Fig.4, and measured residual stresses obtained with hole drilling method are plotted onto the same graph for a direct comparison.



A comparison on predicted and measured residual stresses along the top surface of the top flange

Fig. 4 Numerical results of thermo-mechanical analysis of the S960 welded H-section after welding

In general, a good comparison between the predicted and the observed results in each of these three areas is attained, and hence, the proposed "thermo-mechanical-metallurgical" simulation approach is shown to have a high level of accuracy in predicting various responses of the high strength steel welded H-sections under the effects of welding. The proposed approach will be extended to cover structural responses of these welded H-sections, and this will be reported separately.

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