CNERC
NEWSLETTER
DECEMBER 2024 ISSUE
SEP - DEC 2024

FEATURE STORY

CNERC Annual Technical Symposium 2024

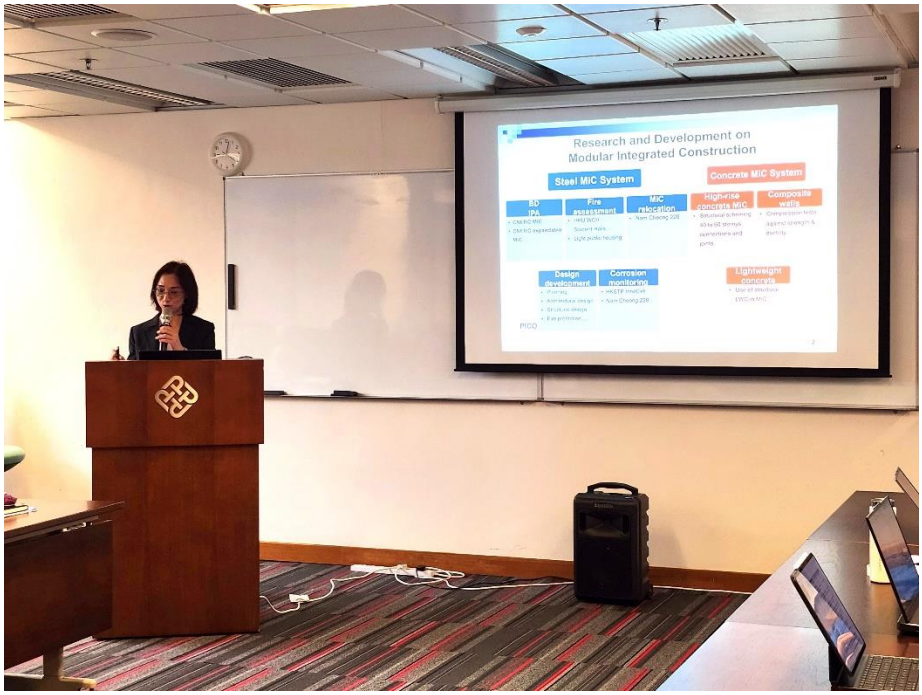
CNERC Annual Technical Symposia are organized as technical platforms to promote technical discussions and exchange among research personnel of CNERC. The first Annual Technical Symposium was held in 2020, and favorable responses were received from Project Investigators and their respective research teams.

The CNERC Annual Technical Symposium 2024 was held on 4 October 2024 as a half-day event, and it was our honour to have **Ir Joseph K. K. Lo, Head of Project Strategy and Governance Office of Development Bureau**, and **Ir Ellen Cheng, Chief Engineer of Civil Engineering and Development Department**, both of the Government of Hong Kong SAR, being our Honorable Judges. An Invited Lecture was made by Dr. M. F. Hui, Principal Research Fellow of CNERC, and a total of 8 presentations were made by postdoctoral fellows and senior research students.

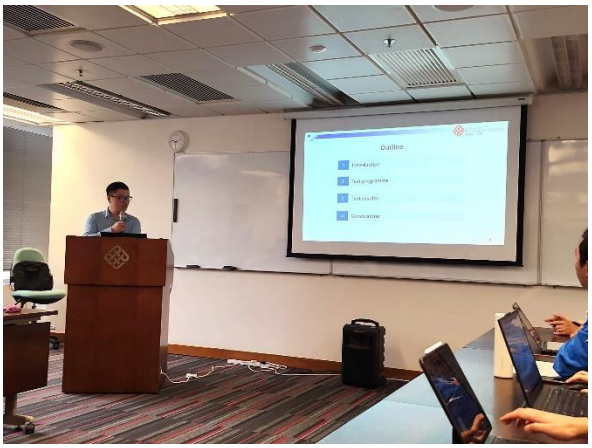
From left: Dr. Andy Leung, Dr. H.C. Ho, Prof. K.F. Chung, Ir Joseph Lo, Ir Ellen Cheng, Dr. M.F. Hui, Prof. Michael Yam and Dr. Y.F. Hu.

The Symposium was kicked off with a welcome speech by Prof. K. F. Chung, Director of CNERC, and followed by an Invited Lecture presented by Dr. M. F. Hui.

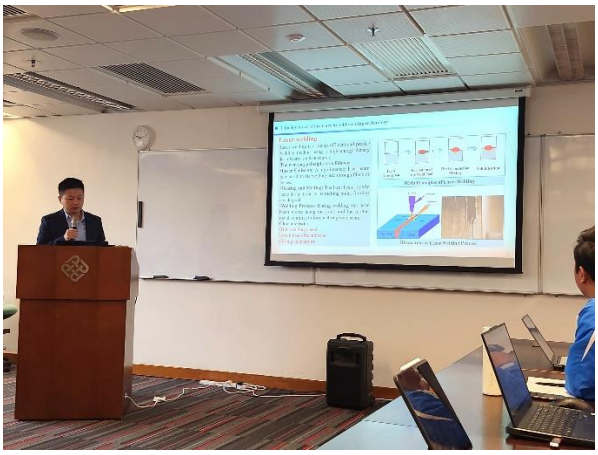
The Symposium was attended by over 30 research personnel of CNERC.



Dr. M. F. Hui presented on “Modular Integrated Construction”.



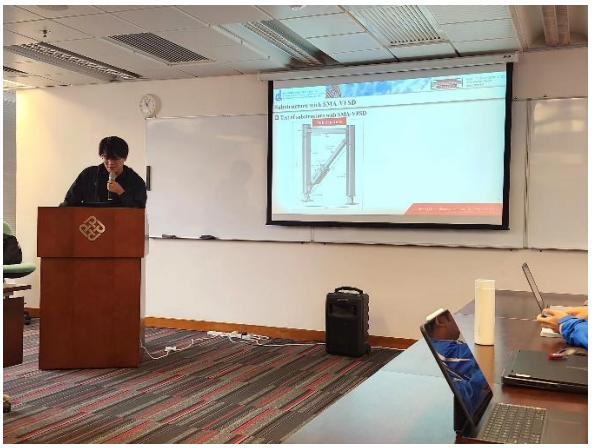
Dr. Pengfei MEN, Postdoctoral Fellow (CEE) presented on “Experimental investigations into stocky composite columns of concrete-filled S690 steel tubes under compression”.



Dr. Keyang NING, Postdoctoral Fellow (CEE) presented on “Mechanical behavior of high strength steel S690 laser-arc hybrid welded butt joints”.

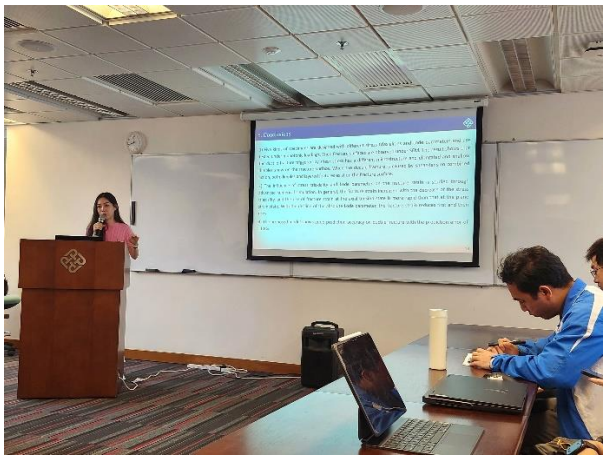
Dr. Bin LI, Postdoctoral Fellow (CEE) presented on “Demonstration of site welding of high strength 690 MPa steel sections in accordance with current practice”.

Dr. Yuzhou WANG, Postdoctoral Fellow (CEE) presented on “Feasibility of using weathering steel with RE addition in marine atmosphere”.



Mr. Ping ZHANG, Research Student (BRE) presented on “Seismic performance of structures equipped with innovative SMA-based resilient damper”.

Mr. Wei CHEN, Research Student (CEE) presented on “Fatigue performance of S690 steel and their welded sections in bridge structures”.



Miss Mengfei LI, Research Student (CEE) presented on "A new ductile fracture model of S690 high strength steel under combined tension and shear actions".

Mr. ABDULLAH, Research Student (CEE) presented on "Investigation of rock-pile interaction by using DFOS technology".

After a rigorous discussion among members of the Judging Panel including Ir Joseph Lo, and Ir Ellen Cheng and Prof. K. F. Chung, the following research personnel were selected as winners of the Young Researchers Competition 2024:

CNERC Outstanding Young Researcher Awards 2024

Mr. Wei CHEN, Department of Civil and Environmental Engineering
Ms. Mengfei LI, Department of Civil and Environmental Engineering

CNERC Young Researcher Awards 2024

Dr. Yuzhou WANG, Department of Civil and Environmental Engineering
Mr. Ping ZHANG, Department of Building and Real Estate
Mr. ABDULLAH, Department of Civil and Environmental Engineering

CNERC Young Researcher Merit Awards 2024

Dr. Pengfei MEN, Department of Civil and Environmental Engineering
Dr. Keyang NING, Department of Civil and Environmental Engineering
Dr. Bin LI, Department of Civil and Environmental Engineering

NEWS

International Infrastructure and Projects Leaders Summit

Prof. K. F. Chung, Director of CNERC was invited by Development Bureau, the Government of Hong Kong SAR to attend the “International Infrastructure and Projects Leaders Summit” which was held on 15 November 2024. Ir Ricky C.K. Lau, Permanent Secretary (Works) of Development Bureau, commended on the research and development work of CNERC on promoting "effective use of high strength S690 and S960 steel in construction". At present, these high strength steel have been adopted in about 50 public works projects in Hong Kong.

The Summit brought together more than 500 project leaders and experts in infrastructure from over 20 countries around the globe to discuss strategies and policies of infrastructure delivery plans, and challenges and opportunities in implementing mega infrastructure projects.

NEWS

Establishment of Guangdong-Hong Kong-Macao Smart Construction Industry Development Alliance cum Guangdong-Hong Kong-Macao Smart Construction Cooperation and Development Conference

Dr. Y. F. Hu, Deputy Executive Secretary and Research Assistant Professor, and Dr. B. Li, Postdoctoral Fellow of CNERC were invited by the Guangdong-Hong Kong-Macao Smart Construction Industry Development Alliance to attend its establishment meeting during 25 – 26 September 2024. At the meeting, the Alliance Charter, Chairman unit, Vice Chairman unit, and Director unit were voted on and passed unanimously. Guangdong Academy of Building Science and Hong Kong Academy of Building Technology were elected as Chairman units, Hong Kong Polytechnic University was elected as Vice Chairman unit, and the Director of the Business Development Department of Guangdong Academy of Building Science was unanimously elected as the Secretary-General of the Alliance.

NEWS

The Third International Workshop on High Performance Steel Structures in Beijing

Dr. Y. F. Hu, Deputy Executive Secretary and Research Assistant Professor, Dr. M. F. Zhu, Postdoctoral Fellow, and Mr. W. Chen of CNERC were invited to attend the Third International Workshop on High Performance Steel Structures in Beijing during 9 – 12 October 2024, and given a presentation each on "Advanced Numerical Simulation on Fabrication Processes of High Strength Cold-formed CHS", "Numerical Simulation of Welding of S960 High Strength Steel Considering Phase Transformation", and "Fatigue Performance of S690 Steel and Their Welded Sections in Bridge Structures" respectively.

NEWS

40th Anniversary of China Steel Construction Society cum China Steel Construction Conference 2024 in Beijing

Prof. K. F. Chung, Director of CNERC, and Dr. X. F. Yang, Postdoctoral Fellow of CNERC were invited to attend the 40th Anniversary of China Steel Construction Society, and the China Steel Construction Conference 2024 held in Beijing on 21 and 22 October 2024. Moreover, Prof. Chung represented the Hong Kong Constructional Metal Structures Association and received the "Best Collaboration Award".

NEWS

2024 Academic Annual Conference of the China Civil Engineering Society in Suzhou

Prof. K. F. Chung, Director of CNERC was invited by the Advanced Engineering Materials Branch of the China Civil Engineering Society to make a plenary presentation entitled “Research, Development, and Engineering Applications of Q690 High-Performance Steel Structures” in its Forum entitled “Advanced Engineering Materials for Construction” on 23 October 2024 in Suzhou.

NEWS

2024 Chief Executive’s Policy Address Innovation and Technology Policy Industry Exchange Meeting

Prof. K. F. Chung, Director of CNERC, was invited by Hon. Duncan Chiu and Hon. Prof. K. F. Wong to attend the Industry Consultant Meeting on Technology and Innovation of Chief Executive's Policy Address 2024. The meeting was held at the Legislative Council Complex in Admiralty, Hong Kong on 1 November 2024. The Secretary for Innovation, Technology and Industry, Prof. D. Sun, reported on various development and new initiatives of the Government to representatives of 77 statutory organizations and associated groups in the “Technology and Innovation” Sector in Hong Kong.

NEWS

HKIE Technical Seminar on the Effective use of High Strength S690 Steel in Construction and Recent Applications

Prof. K. F. Chung, Director of CNERC, was invited by Ir Sammy Lai, Chairman of the Building Division of the Hong Kong Institution of Engineers to make a presentation entitled “Effective Use of High Strength S690 Steel in Construction and Recent Applications” at its InnoCarnival Webinar in HKIE’s Headquarter in Causeway Bay on 4 November 2024. The event was attended by about 30 engineers and 600 participants in hybrid mode.

NEWS

First International Conference on Engineering Structures of the international journal, “Engineering Structures”

Prof. K. F. Chung, Director of CNERC was invited by Prof. J. Yang, Editor-in-Chief of the International Journal "Engineering Structures", to attend the First International Conference on Engineering Structures held at Guangzhou as a member of the Journal's Editorial Board on 9 November 2024.

Prof. Chung took a photo with Prof. S. Kitipornchai and Prof. Paul Lam.

NEWS

One-Day Seminar - Innovating Towards a Sustainable Built Environment organized by Department of Civil and Environmental Engineering, PolyU

Prof. K. F. Chung, Director of CNERC was invited by the Department of Civil and Environmental Engineering, PolyU as Plenary Speaker to give a presentation at the One-Day Seminar - Innovating Towards a Sustainable Built Environment on 23 November 2024.

NEWS

Guangdong Provincial Steel Structure Association's 30th Anniversary Celebration Conference

Prof. K. F. Chung, Director of CNERC, and Dr. B. Li, Postdoctoral Fellow, were invited by Prof. Z. M. Chen, President of the Guangdong Steel Structure Association, to participate in the 30th anniversary celebration of the Guangdong Steel Structure Association on 23 November 2024.

NEWS

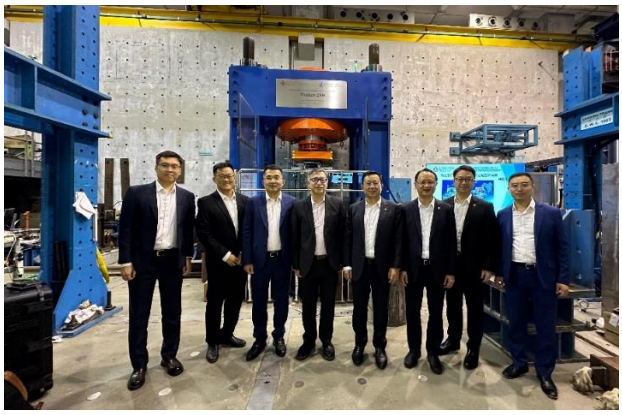
CIC R&D Conference 2024

The Construction Industry Council held a R&D Conference 2024 on 12 December 2024 at CIC Zero Carbon Park, and invited Prof. K. F. Chung, Director of CNERC to be a speaker in sharing his S690/S960 and AI Rock research and application on S690 Steel.

VISIT

Prof. J. P. Hao, President of China Building Metal Structure Association led a delegation team to visit CNERC on 12 September 2024.

Academician C. F. Li of the Chinese Academy of Engineering and Professor D. S. Li, Vice President of China Three Gorges University, led a delegation team to visit the CNERC on 13 September 2024.



Mr. H. T. Wu, Chairman of China State Construction Engineering Corporation led a delegation team containing representatives from CSCEC Green Technology Co. Ltd. and China Steel Structure Co. Ltd. to visit the CNERC on 14 November 2024.

Prof. K. F. Chung, Director of CNERC together with Dr. H. C. Ho and Dr. Y. F. Hu visited the Headquarter of the newly established Building Technology Research Institute (BTRi) in Wan Chai on 27 November 2024. BTRi is a limited company wholly owned by the Financial Secretary Incorporated, and it aims to promote innovative applications in the construction industry.

Ir C. K. Hon, Chairperson of Building Technology Research Institute (BTRi) led the delegation team of BTRi to visit CNERC on 5 December 2024.

Prof. L. W. Tong from Tongji University visited CNERC on 13 December 2024.

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 researcher's contact information is available right at the end of each article.

RESEARCH

Investigations into mechanical properties of 50 and 70 mm thick high strength S690 butt-welded sections

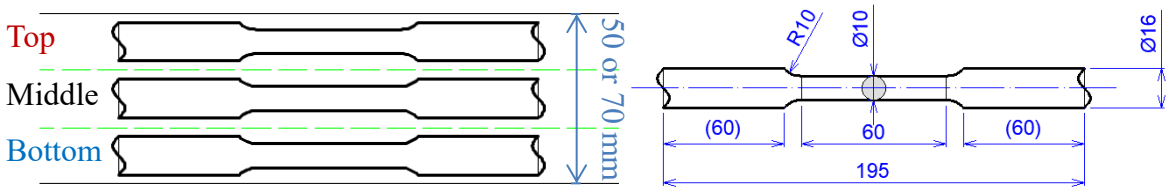
In order to facilitate effective use of these high strength S690 steel in construction, a comprehensive investigation into the after-weld mechanical properties of 50 and 70 mm thick high strength S690 steel butt-welded sections was presented.

- Firstly, a total of 18 standard coupons with circular cross-sections were extracted at three different layers within the plate thicknesses to study the variation of mechanical properties.
- Secondly, standard coupons were extracted from these 50 and 70 mm thick welded sections with various heat input energy to find the effects of welding on the mechanical property changes.

1. Experimental investigation into base plates

In a typical production of the high strength S690 steel, the steel goes through a highly controlled heat treatment process. Owing to significantly different cooling conditions at the outer surfaces, when compared with that at the core in steel plates, temperatures along the thickness direction may not be uniform during the hot rolling process. This will lead to a significant difference in their microstructure, and hence, the mechanical properties of the steel at different layers along their thickness directions.

Fig. 1a) illustrates the arrangements of the coupons to be extracted from both the 50 and the 70 mm thick steel plates, i.e. at different layers along the plate thickness. The dimensions of test coupon are given in Fig 1b).



a) Coupons at different layers b) Typical dimensions of coupon

Fig. 1 Design of coupons of 50 and 70 mm thick S690 QT thick steel plates

Fig. 2 plots the full range engineering stress-strain (σ - ε) curves of these coupons onto the same graphs for a direct comparison. It is shown that for the 50 mm thick steel plates, the mechanical properties have a variation less than 1% at various layers along their thicknesses. However, for the 70 mm thick steel plates, the mechanical properties have a variation at 8.5% at various layers along their thicknesses. More specifically, significant reductions to both the yield and the tensile strengths of those coupons extracted from the middle layers of the steel plates are found, when compared with those from the top and the bottom layers; these reduction factors are found to be to 0.93 and 0.94, respectively.

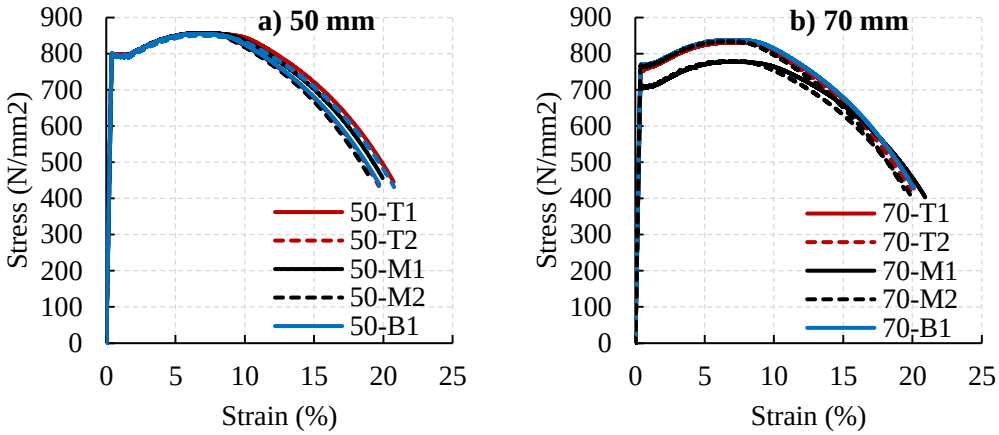
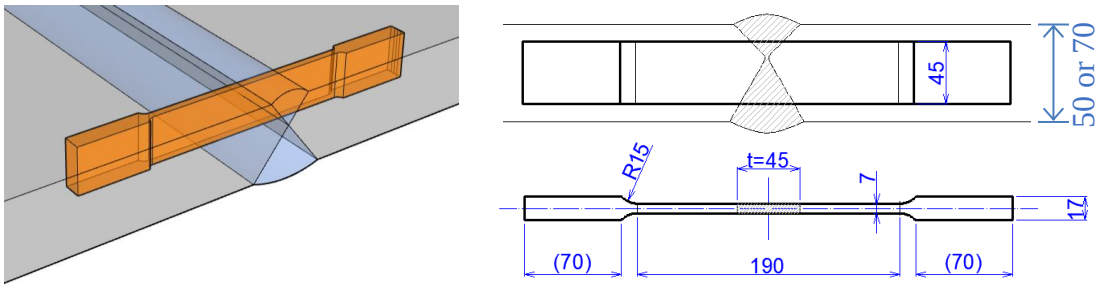


Fig. 2 Full range engineering stress-strain curves of base plates

2. Experimental investigation into welded sections

Submerged arc welding (SAW) was employed for welding of these 50 and 70 mm thick steel plates using three different heat input energy q, i.e. 2.4, 3.5, and 5.0 kJ/mm, during welding. In order to achieve butt-welded sections with a minimum amount of welding, an X-shape groove was adopted. These butt-welded sections were sent out for machining to prepare test coupons according to the dimensions given in Fig. 3. It should be noted that the height of these coupons is specified to be 45 mm, and they are readily cut from both the 50 and the 70 mm thick plates.



a) Standard coupon b) Typical dimensions of coupons

Fig. 3 Extraction and dimensions of S690 QT tensile test coupons

A total of 22 coupons were tested successfully. Fig. 4 plot the measured stress-strain curves of the coupons of the 50 mm and the 70 mm thick steel plates and their welded sections.

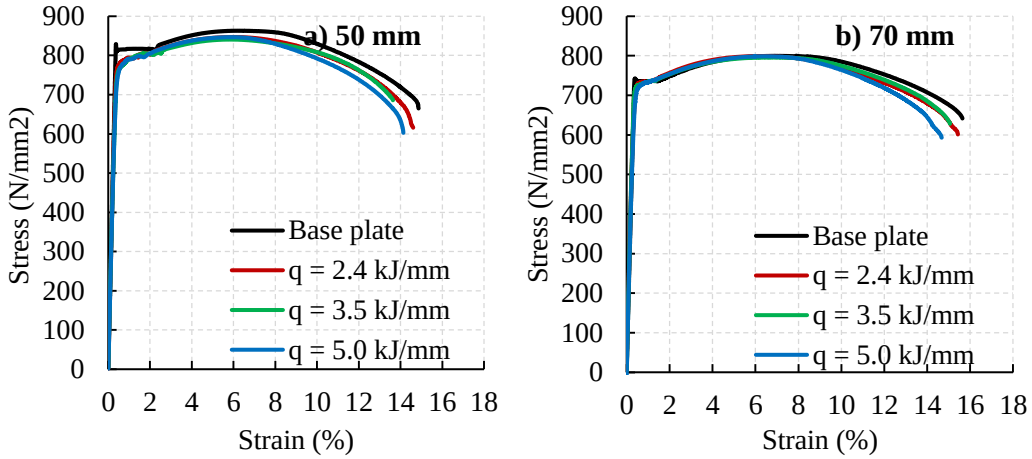


Fig. 4 Full-range engineering stress-strain curves of coupons of 50 and 70 mm thick welded sections

It is found that:

a) For the 50 mm thick sections, the corresponding average tensile strengths are shown to decrease from 865 to 825 N/mm^2, i.e. 5% of that of the base plate. The values for 70 mm thick sections are shown to vary from 800 to 795 N/mm^2, i.e. ≤ 1% of that of the base plate.
b) Compared with the 16 mm thick S690 QT welded sections examined before, the mechanical properties of both the 50 and the 70 mm thick S690 QT welded sections are found to have only small reductions over the range of heat input energy q covered in the present investigation. Hence, the effects of welding onto the mechanical properties in these 50 and 70 mm thick steel plates are significantly smaller, when compared with those in the 16 mm thick steel plates.

Hence, full strength butt-welded sections between these thick S690 steel are readily achieved in practice, similar to those of the commonly adopted S355 steel. These important findings are contrary to general understanding as many researchers and engineers consider that the mechanical properties of these high strength S690 steel are reduced significantly after welding, irrespective of their plate thicknesses.

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