

# CNERC

# NEWSLETTER

APRIL 2020 ISSUE  
JANUARY - APRIL 2020

## FEATURE STORY

### CNERC Annual Report 2019

The Chinese National Engineering Research Centre for Steel Construction (Hong Kong Branch) is pleased to share the CNERC Annual Report 2019 (abridged version), which can be downloaded at our website:

<https://www.polyu.edu.hk/cnerc-steel/en/publications/annual-report/annual-report-2019>

The CNERC Annual Report 2019 is submitted to the State Ministry of Science and Technology via the Innovation and Technology Commission on 31 March 2020. Covering the period from 1 January 2019 to 31 December 2019, the CNERC Annual Report aims to report the research progress and achievements, personnel movement, financial summary, and all relevant activities of the Centre.

All the CNERC Annual Reports in both English and Chinese since 2016 are available in the CNERC website:

<https://www.polyu.edu.hk/cnerc-steel>

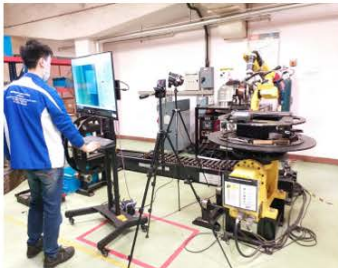


CNERC Annual Report 2019.

## CNERC Achievements in Modern Steel Construction Technology

### Research Activities and Achievements on High Strength S690 Steels in Construction

- a) microstructural changes in heat-affected zones of S690 to S960 welded H-sections and cold-formed tubular sections, and their modified mechanical properties at large deformations under cyclic actions;
- b) contribution to the new generations of Structural Eurocodes in steel construction on effective use of high strength S690 to S960 steels in i) ductility requirements, ii) mechanical properties of welded sections, iii) accurate prediction on resistances of members and joints, and iv) robotic welding;
- c) welding technology and quality control on using 50 to 70 mm thick S690 steel plates to form 200 m long Compression Chords (with a cross-section dimension of 3.0 x 3.0 m to 3.5 x 3.5 m) of the Cross Bay Link Bridge in Tseung Kwan O; and
- d) development of high strength S690 to S960 steels in pre-fabricated construction systems and modular integrated construction in residential buildings, and long span composite bridges.



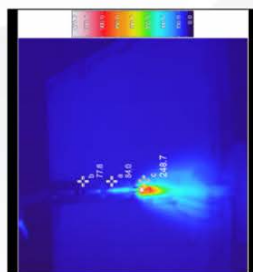
Welding Laboratory  
(Laboratory W001)



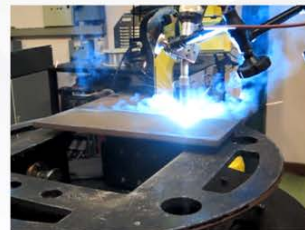
Robotic Welding System  
Fanuc ARC Mate 100iC



### Robotic welding and monitoring



Surface temperatures and thermal images

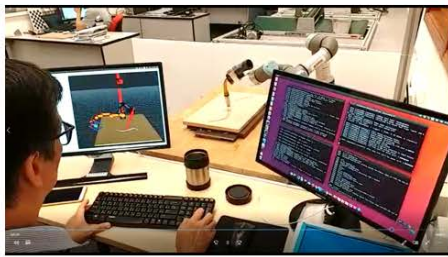


Robotic welding system

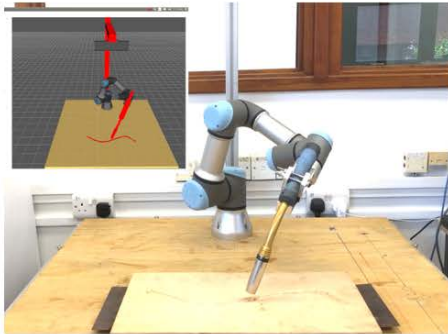
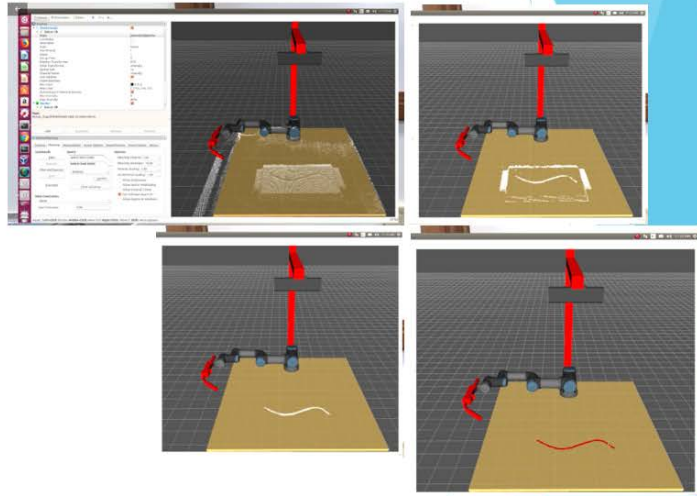


Molten weld metal

## Robotic Welding Technology through Point Clouds under Computer Vision



Real time static trajectory planning

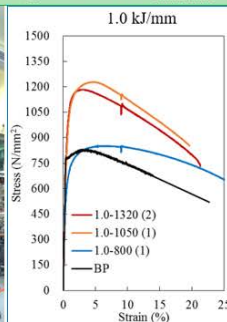


Universal Robot UR3 controlled through Robot Operating Systems ROS originated from Stanford Research Institute, U.S.A.

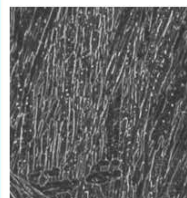
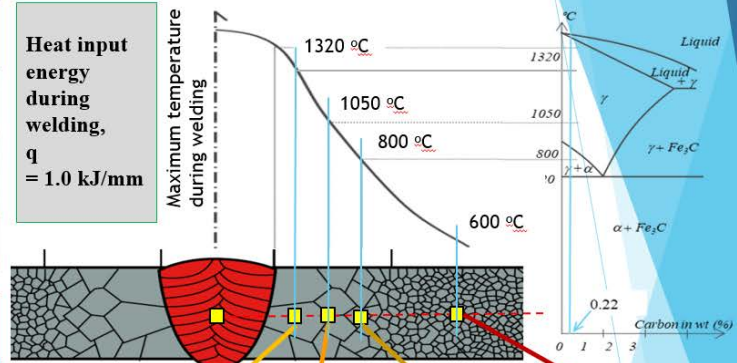
### Heat-treated funnel shaped coupons of S690 steels – Gleeble at Shougang Steel



### Tensile tests on heat-treated coupons – Instron Fatigue Testing Machine at PolyU

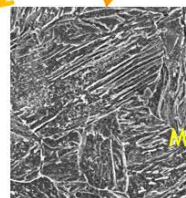


Heat input energy during welding,  
 $q = 1.0 \text{ kJ/mm}$



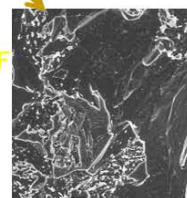
Long lath martensite

HAZ-HT 1320 °C



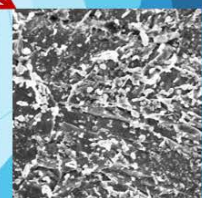
Short lath martensite

HAZ-MT 1050 °C



Tempered martensite & ferrite (dual phase)

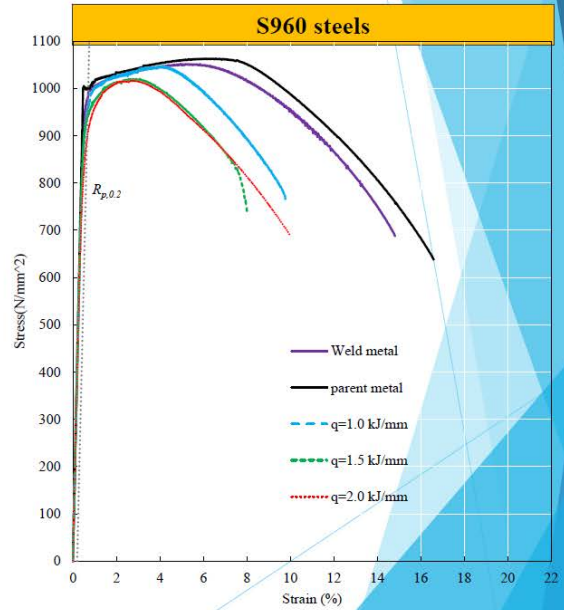
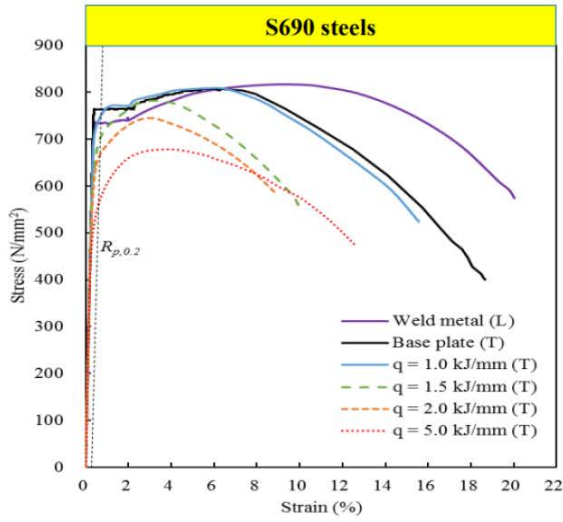
HAZ-LT 800 °C



Parent metal

Parent metal

## Engineering stress-strain curves for S690 and S960 welded sections



## Stocky columns of S690 welded H-sections with splices



### Typical failure modes

Heat input energy = 1.0 kJ/mm

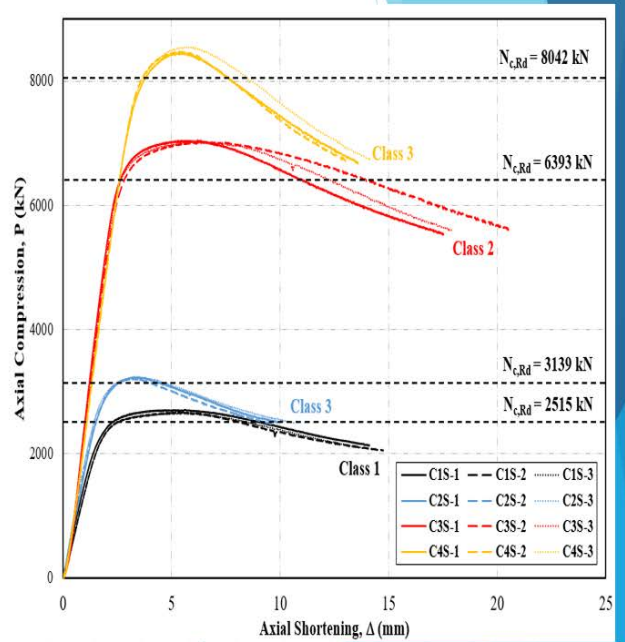


Section C1S

Section C2S

Section C3S

Section C4S



## Welding technology and monitoring on high strength S690 welded sections

The TKO Cross Bay Link is a dual two-lane carriageway of approximately 1.8 km long with a cycle track and a footpath across the Junk Bay in Tseung Kwan O.

Project Management : Civil Engineering and Development Department  
Consulting Engineers : AECOM Asia Co. Ltd.  
Contractor: China Road and Bridge Corporation



Commencement Date: July 2018  
Completion Date: 2022  
Project Sum: HK\$ 2.5 billion

## Welding technology and monitoring on high strength S690 welded sections

The TKO Cross Bay Link is a dual two-lane carriageway of approximately 1.8 km long with a cycle track and a footpath across the Junk Bay in Tseung Kwan O.



The compression curved chords

- weight 4,400 tons of S690 steels
- welded box sections 3 x 3 m to 3.5 x 3.5 m with 50, 60 and 70 mm thick plates

The 200 m long main span bridge segments are fabricated in Shanghai, and towed to Tseung Kwan O as a whole for installation.

In order to promote effective design and construction of steel construction using Chinese steel materials and structural steelwork in Hong Kong and neighbouring cities, the CNERC has published the following major professional publications in addition to the journal papers and conference papers:

**Professional publications**

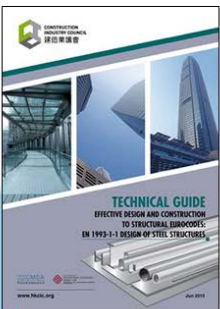


Professional Guide *Selection of Equivalent Steel Materials to European Steel Materials Specifications*



Professional Guide *Design and Construction of High Rise Residential Buildings in Hong Kong using Prefabrication and Mechanization*

Technical Guide *Introduction to Chinese Steel Construction Industry: Steel production and technical specifications*



Technical Guide *Effective Design and Construction to Structural Eurocodes: EN 1993-1-1 Design of Steel Structures*



Professional Guide *Design of Buildings and Structures in Low to Moderate Seismicity Regions*

Technical Report *Marketing Strategies for Development of Steel Construction in Hong Kong*



## UPCOMING EVENTS

For details of the CNERC's upcoming events, please check out our website at:  
<https://www.polyu.edu.hk/cnerc-steel/en/news-events/upcoming-events>

## CONTACT US

**Address: Chinese National Engineering Research Center for Steel Construction (Hong Kong Branch)  
 The Hong Kong Polytechnic University,  
 Phase 8, Hung Hom, Kowloon, Hong Kong.**

**Phone: (852) 3400-8451**

**Email: [cnerc.steel@polyu.edu.hk](mailto:cnerc.steel@polyu.edu.hk)**