

CNERC

NEWSLETTER

DECEMBER 2022 ISSUE SEP - DEC 2022

FEATURE STORY

Construction R&D Forum – *Bringing Applied R&D to New Heights* Development Bureau, the Government of Hong Kong SAR

Ir Prof. K.F. Chung, Director of CNERC, and Ir Prof. Michael C.H. Yam, Deputy Director and Executive Secretary of CNERC, were both invited to deliver a presentation on the **Construction R&D Forum** at the Grand Hyatt Hotel, Wan Chai on 4 November 2022. The theme of the Forum is “*Bringing Applied R&D to New Heights*”. The title of the presentation by Prof. Chung was “*Effective use of high strength S690 steel in construction – A journey from research and development to engineering application*” while that of Prof. Yam was “*The Smart Construction ERA: Education, Research and Application*”.

The Forum was jointly organized by the Development Bureau (DEVB) of the Government of Hong Kong SAR and the University-Government-Industry Consortium. The event was officiated by:

- **Mr. Paul M.P. Chan** *GBM, GBS, MH, JP*
Financial Secretary, the Government of Hong Kong SAR
- **Ir Prof. J.G. Teng** *JP*
President, the Hong Kong Polytechnic University
- **Ms. Bernadette H. H. Linn** *JP*
Secretary for Development, Development Bureau, the Government of Hong Kong SAR
- **Ir Dr. Andrew K.C. Chan** *BBS, JP*
Chairman of Steering Committee, UGI Consortium for Sustainable Urban Development
- **Ir Ricky C. K. Lau** *JP*
Permanent Secretary for Development (Works), Development Bureau, the Government of Hong Kong SAR



Opening Ceremony of the Construction R&D Forum by Ir Ricky Lau, Prof. J.G. Teng, Mr. Paul Chan, Ms. Bernadette Linn and Dr. Ir Andrew Chan

Through the Centre of Excellence for Major Project Leaders under **the Project Strategy and Governance Office** of the Development Bureau, the Forum brought together about 400 scholars and stakeholders from the Government and the industry. The Forum was an industrial-wide platform to exchange views on promotion and adoption of applied R&D to enhance the industry performance in order to cope with the challenges ahead. It was also part of the celebration of the 25th Anniversary of the Government of Hong Kong SAR.

During his Opening Address, **Mr. Paul Chan** said that the construction industry had long been indispensable to the economic development of Hong Kong. Infrastructure investment was always one of the vital factors underpinning economic revival of Hong Kong. In the next few years, the Government's capital works expenditure would exceed HK\$100 billion a year, and the overall construction volume of Hong Kong would soar to some HK\$300 billion a year. However, Mr. Chan pointed out that the construction industry was facing various challenges such as high construction costs, site safety issues and expectation to deliver results faster and more efficiently. Innovation was the key to tackle these concerns. A closer tripartite collaboration among the Government, the Universities and the Industry would help the Industry embrace innovation supported by applied R&D. The Government would spearhead applied R&D, pilot use of new materials, construction methods and technology in public works projects so that they would serve as a reference for an industrial wide adoption.

While speaking in a keynote presentation, **Ms. Bernadette Linn** said the Government would play a key role in driving construction innovation, in particular, promoting applied R&D in public works projects. The DEVB had set up a taskforce to steer and formulate policies on applied R&D, and to provide support and guidelines to various works departments and authorities with a view to achieving a wider adoption of innovation and technology in the construction industry. Ms. Linn called for support from the Industry in promoting applied R&D to support construction innovation, thereby enhancing the performance and sustainability of the Industry. She added that with Hong Kong's world-class expertise and experience in construction, the Industry would contribute to the development of Hong Kong as well as the realisation of the country's vision to become a global leader in innovation.

When concluding the Forum, **Ir. Ricky Lau** called for a change of mind-set, and urged the industry stakeholders to embrace innovation, equip themselves with innovative R&D outcomes, and drive for excellence in project performance, so as to contribute to the sustainable development of the Industry.

Ir Prof. K. F. Chung presented a comprehensive report on key research and development activities on high strength S690 steel undertaken at the University since 2010. He also explained key structural and economical advantages of adopting these high strength S690 steel in construction. Innovative engineering applications of these S690 steel were fully illustrated in

- the Double Arch Steel Bridge of the Cross Bay Link in the Tseung Kwan O area,
- the long span steel trusses in the Kowloon Tsai Swimming Pool, and
- the two long span steel roofs of the Yuen Long Stadium.



Prof. Chung presenting at the Construction R&D Forum
Presentation title: *Effective use of high strength S690 steel in construction – A journey from research and development to engineering application*



Prof. Yam presenting at the Construction R&D Forum
Presentation title: *The Smart Construction ERA: Education, Research and Application*

During his presentation, Prof. Michael Yam called for a continual industry-wide adoption of innovative technology and management among various stakeholders of the Construction Industry. All these efforts would certainly help the industry get ready for many huge infrastructure projects of the HKSAR Government.

CNERC-Beijing – Seminar on "Engineering Application of High Strength Q690 Steel Structure in Buildings and Bridges"

Prof. K. F. Chung, Director of CNERC was invited by the CNERC-Beijing to give an online presentation at their Seminar on "Engineering Application of High Strength Q690 Steel Structures in Buildings and Bridges" together with Dr. H. C. Ho and Dr. Y. F. Hu on 9 September 2022. The Seminar was hosted by Mr. Wang Yuedong, Senior Engineer & Deputy Director of CNERC-BJ and the MCC Group.

Organizer: CNERC-Beijing
Hong Kong Branch of CNERC

Co-Organizer: China Metallurgical Construction Research Institute Co., Ltd.

Supporting organizations:

China MCC Prefabricated Building (Beijing) Technology Research Institute
China Steel Structure Association Building Steel Structure Branch
National Steel Structure Engineering Technology Research Center Steel Structure Classic Research Institute
Ansteel Group
Wuhan Iron and Steel Group
Baosteel Group
Nanjing Iron and Steel Group
Shanxi Jianlong Industrial Co., Ltd.
Hebei Jinxi Iron and Steel Group Co., Ltd.

The Seminar was attended by more than 150 people for exchange through an online platform from more than ten corporations in steel related industry of Mainland China, including steel enterprises, scientific research institutions, universities and institutes, and associations.

国家钢结构工程技术研究中心学术交流

2022年9月9日14:00-16:00
线上会议
腾讯会议：200-872-852

报告主题：高强Q690钢材结构在建筑和桥梁的工程应用

特邀专家

鍾國輝 教授
香港理工大学
国家钢结构工程技术研究中心
香港分中心主任

何浩祥 博士
香港理工大学
国家钢结构工程技术研究中心
香港分中心常务副秘书长

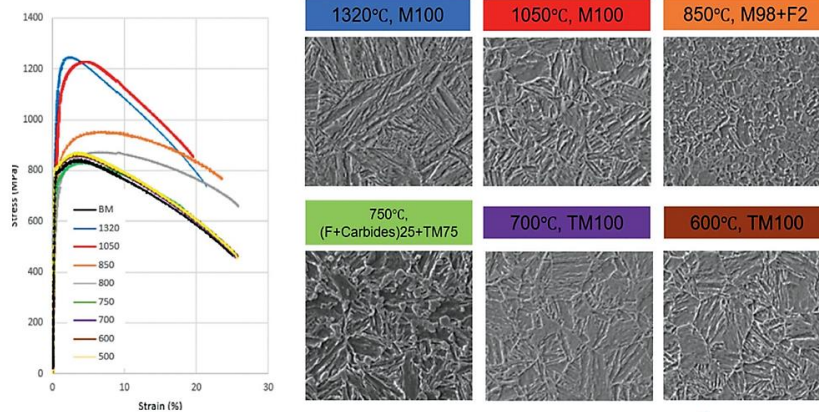
胡亦非 博士
香港理工大学
国家钢结构工程技术研究中心
香港分中心助理教授

国家钢结构工程技术研究中心，原属于中国建筑科学研究院有限公司，于2007年由住房和城乡建设部批准建设，2011年4月通过验收正式命名，是我国钢结构领域唯一的国家建筑工程技术研究中心。国家钢结构工程技术研究中心香港分中心于2015年10月获得中华人民共和国住房和城乡建设部批准在香港理工大学成立，是第一个被授权与促进香港建设研发和工程应用的分中心。

Q690高强钢标准热处理试件的应力应变曲线及微观结构

通过合理控制焊接热输入值，在不同的热处理试件中，焊接构件的微观结构会呈现出不同的

板厚 = 16 mm, 热输入量 = 1.0 kJ/mm, 冷却速率 $t_{8/5} = 5.5$ s



During the Seminar, Prof. Chung shared information on the establishment of the CNERC and its research achievement in “Effective application of Q690 steel in construction”, and gave a detailed explanation from the material properties of Q690 high strength steel to engineering applications. Relevant research results in recent years were also introduced in details. Moreover, Dr. Hu, Research Assistant Professor shared a special report on “Structural Properties of High Strength Q690 Steel Cold-Formed Thin-Walled Circular Section T-Joints”. The online participants had an in-depth exchange on the technical and market issues of Q690 steel material development, welding performance, structural application, etc.

Visit of Buildings Department of the Government of Hong Kong SAR

Ms. Clarice Yu, JP, Director of Buildings Department (BD) of the Government of Hong Kong SAR led a team of engineering and technical delegates from BD visited CNERC to explore use of high strength S690 steel in construction on 16 November 2022. Prof. K. F. Chung, Director of CNERC, together with CNERC office bearers received the BD delegates as follows:

BD delegates:

- YU PO MEI CLARICE, Director of Buildings
- HO CHUN HUNG, Deputy Director
- CHAN YUEN MING MARY, Chief Building Surveyor
- LOK PUI FAI, Chief Structural Engineer
- CHAN CHEUK MING, Structural Engineer
- CHAN WING YEUK, Structural Engineer
- CHAN YIU KI, Technical Officer
- CHAN YUN KEUNG, Structural Engineer
- CHEUNG PAT WANG, Structural Engineer
- KONG CHUN PANG, Structural Engineer
- KWAN SIU FUNG, Senior Technical Officer
- LAI CHING HO, Structural Engineer
- LEE YAU SHING, Structural Engineer
- TANG CHUN WAN, Senior Technical Officer
- WONG KWAN WEI MELODY, Structural Engineer
- WONG PIK HAN PHOEBE, Structural Engineer
- YEUNG KIN HEI, Technical Officer
- YU KIN HO, Structural Engineer
- YU TAK WAI TOMMY, Senior Structural Engineer
- YUEN YIU MAN, Structural Engineer

CNERC office bearers:

- Prof. K. F. Chung, Director of CNERC
- Prof. Michael C. H. Yam, Deputy Director and Executive Secretary of CNERC
- Dr. Lilian M. F. Hui, Principal Research Fellow
- Dr. H. C. Ho, Deputy Executive Secretary and Research Assistant Professor of CNERC
- Dr. Y. F. Hu, Research Assistant Professor of CNERC



A group photo of BD delegates together with CNERC office bearers



The BD delegates visiting Laboratory Y001 (left) and Laboratory W002 (right)

The delegates visited the Structural Engineering Research Laboratory (Y001) and the Welding Laboratory (W002) of PolyU, and they were introduced about the research and testing capabilities of the CNERC for large-scale structural tests. The delegates were also introduced to a number of research and development projects on high strength S690 and S960 steels.



From left: Mr. C. H. Ho, Prof. K. F. Chung, Ms. Clarice Yu and Dr. Lilian Hui

After the laboratory tour, a discussion on applied research and development on high strength S690 steel construction was held among BD and CNERC. The following items were presented and discussed:

- a) Missions and visions of CNERC and its recent research achievements
- b) Applied R&D adopting S690 steel in construction
- c) Re-engineering of pilot public works projects using high strength S690 steel, and availability of qualified welders for S690 structural steelwork
- d) Corrosion of aluminum window frames, and its mechanism

CIC Expo 2022

The Construction Innovation Expo was held from 13 to 17 December 2022, which aimed to display emerging and advanced technologies, with the vision of promoting innovations in the construction industry and discover business opportunities in Hong Kong, the Mainland and overseas. The CIExpo was co-organised by:

- Development Bureau, the Government of the Hong Kong Special Administrative Region
- Centre of Science and Technology Industrial Development (CSTID), the Ministry of Housing and Urban-Rural Development of the People's Republic of China
- Construction Industry Council (CIC), Hong Kong



Our CNERC has participated in the CIC Expo 2022 at the Hong Kong Convention and Exhibition Centre, and together with DISI of PolyU, we have received a Merit Award of “CIC Construction Innovation Award 2022”, which was presented on 13 December 2022.



Prof. K. F. Chung, Director of CNERC giving a presentation at the InnoTech Expo 2022 on 13 December 2022 attended by over a hundred of local secondary school students.



Prof. K. F. Chung, Director of CNERC and Council Member of CIC and Ir Thomas Ho, Chairman of CIC at the CIC Construction Innovation Expo 2022.



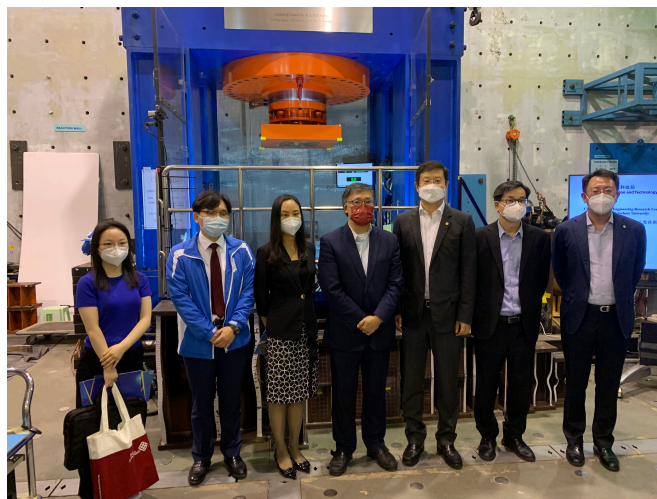
Prof. K. F. Chung, Director of CNERC attended Greater Bay Area Construction Summit during the CIC Expo 2022.

NEWS

In this quarter, CNERC has arranged many laboratory tours cum technical meetings including visitors from works departments of the Government of Hong Kong SAR, professional bodies, and industrial counterparts.



Mr. Huang Jiang, Director & Vice President of China State Construction Engineering (HK) Ltd. and his team visited CNERC on 1 September 2022.



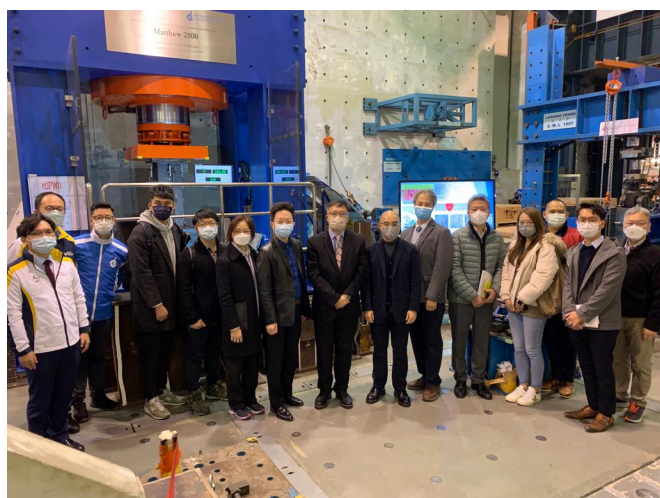
Mr. Deng Renjie, Deputy General Manager of The China Merchant Group visited CNERC on 6 September 2022.



Delegates of China Road and Bridge Corporation visited CNERC on 7 September 2022.



Mr. Yu Cong, General Manager Assistant, Executive Director, Hong Kong & Macau Branch of China Civil Engineering Construction Corporation visited CNERC on 8 September 2022.



Mr. Stephen K. M. Leung, JP, Deputy Director of Housing Bureau led a number of engineers to visit CNERC on 20 December 2022.



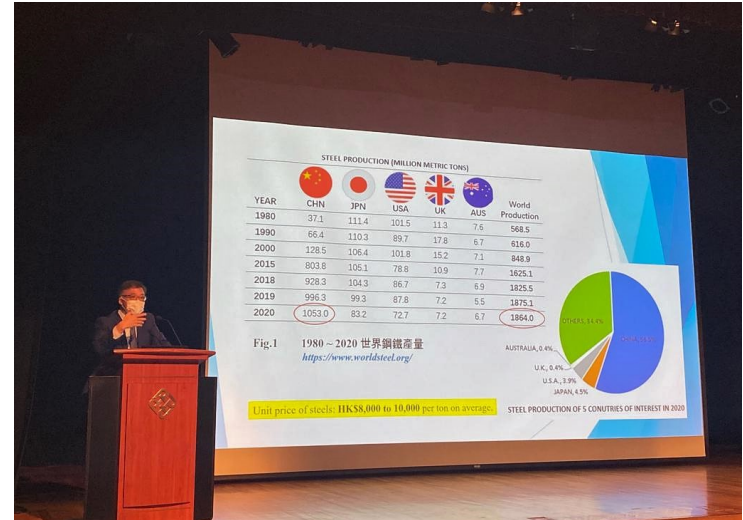
Dr. H. Liang from the Ministry of Housing and Rural Development of the People's Republic of China visited CNERC on 22 December 2022.

CONFERENCES & SEMINARS

During the pandemic, CNERC continues to participate in various conferences/seminars and activities.



Development Bureau and the Construction Industry Council co-organised the Celebration of BIM Achievement (CBA) on 19 October 2022, and Prof. K. F. Chung was being invited as both Organising Committee and Judging Panel for the CBA 2022. The CBA aims to inspire organisations and practitioners to continually be creative, innovative, transformative or disruptive in bringing BIM to its full potential, by recognising and sharing their achievements with all stakeholders.



Prof. K. F. Chung and Dr. H. C. Ho were invited by the Project Strategy and Governance Office of the Development Bureau to present in the First Topical Seminar entitled "Effective Use of High Strength S690 Steel in Construction" under its Project Delivery Capability Programme at Chiang Chen Studio Theatre, PolyU on 27 October 2022. A total of 85 architects, project managers and engineers from various government departments attended the Seminar.



Prof. K. F. Chung, Director of CNERC and Council Member of CIC and Ir Thomas Ho, Chairman of CIC at the 15th Anniversary Celebration of the Construction Industry Council (CIC) and the Hong Kong Construction Exhibition Grand Opening Ceremony at the Main Hall of the M+ Museum at the West Kowloon Cultural District on 31 October 2022.



Prof. K. F. Chung, Director of CNERC (left) was invited by Mr. Peter Yan, CEO of Cyberport (right) to present CNERC's latest research work in a sharing session held at the Cyberport on 2 December 2022.

AWARDS



We are honoured to receive the **Merit Award** of Construction Industry Council (CIC)
“CIC Construction Innovation Award 2022”
on 13 December 2022.

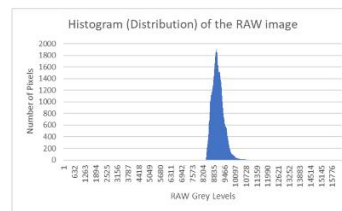
RESEARCH

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 work, 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.

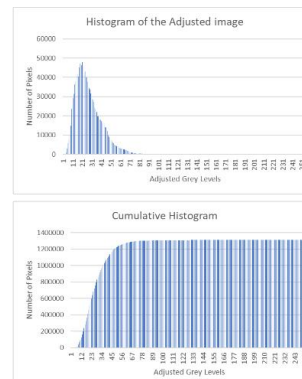
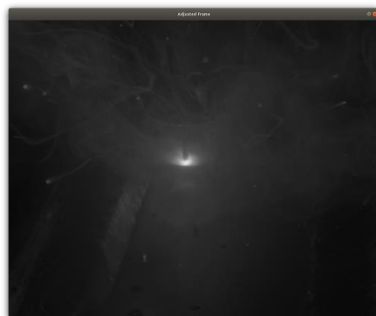
High Dynamic Range imaging of Electric Arc Welding

It is well known that the brightness of Electric Arc Welding is harmful to naked human eyes. At the same time, it is very important for a Professional Welder to have a clear view of the Workpiece, the Welding Track and even the Molten Pool during Welding to perform professionally. Masks and helmets are the usual necessary equipment for the work. However, anyone who has actually used them and performed welding understands much clearer and brighter views of the welding scene are very desirable.

Recent advancement of Photographic Equipment, Digital Imaging Technologies, and Fast Computers have helped. First, advancements of imaging sensors, mainly CMOS (Complimentary Metal Oxide Semiconductor) sensing chips with Logarithmic Responses enabled HDR (High Dynamic Range) cameras to cope with brightness difference (Contrast) of up to 1:10 million (140 dB). A camera from the French Company, New Imaging Technologies, MC1003 was employed in research to capture Electric Arc Welding. The camera produces image outputs in 14 bits for every pixel. That is, for every pixel, the best it can do is to distinguish brightness in 2^{14} or 16,384 grey levels. An example of a Raw image during welding:

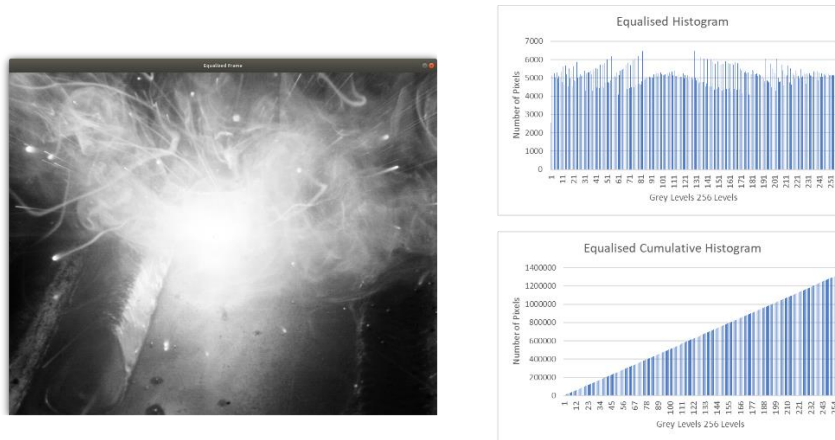


It can be seen, from the Histogram, that the camera can cope with a much wider range of brightness, but all the pixels of the image lie only in the middle of its range. Hence the image is mostly grey, for it is almost mid-way between black and white. To improve the image, one can stretch the range of the image to cover the full range of displayable grey levels. Normal Display Monitors can only display 2^8 or 256 level of brightness. The same image after stretching the grey levels range between 0 to 255:

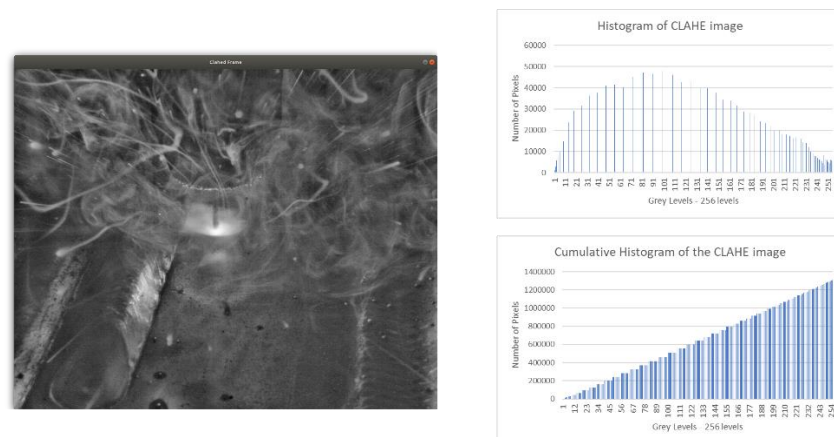


This image is very much like what one can see behind most of the welding masks and helmets. Because the bright molten pool is much brighter than most of the rest of the image.

Most of the pixels are on the right of the histogram meaning most of them are relatively dark. The grey levels in between the brightest spot and the dark regions are not used. Therefore, people came up with the idea that if the grey levels in between can be evenly distributed between the pixels then the grey levels will be much better used. Hence the Histogram Equalization is being used in image processing. The same image is then processed by Histogram Equalization below:



This image is far too bright to make any sense of what is happening at the welding point or the molten pool. This is caused by far too many pixels are used to represent the brighter regions of the image. Then, Karel Zuiderveld of Utrecht University of Holland, came up with the CLAHE (Contrast Limited Adaptive Histogram Equalization) back in 1994[1]. This method is mainly used in medical imaging, where most of the images produced by X ray or MRI face similar images.



This image, comparing with the preceding images, is much better. Both the welding point (molten pool) and the surrounding of the workpiece can be clearly seen. Unfortunately, the spatters and the smoke are also visible. Recently some welding equipment vendors are coming up with self-fume removing torch. Hopefully that will improve the situation much better.

[1] Karel Zuiderveld, Contrast Limited Adaptive Histogram Equalization, Graphics GEMS IV, edited by Paul S. Heckbert.

Researcher: Victor Wu (Email: victor.wh.wu@polyu.edu.hk)

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