Technical Activities and Achievements

2015 to 2018
1. Overview

The core objectives of the CNERC are:

- To establish a high level technological platform to promote effective design and construction of modern building and civil engineering structures as well as sustainable infrastructure development in Hong Kong.

- To advance technological capabilities of Hong Kong Construction Industry in design and construction of super high-rise buildings, long span bridges and buildings of large enclosure using high performance materials in Hong Kong as well as in overseas.
On 6th December 2015, **Mr. Wan Gang**, Head of Ministry of Science and Technology, the People’s Republic of China presented the Official Plague of “Chinese National Engineering Research Centre for Steel Construction (CNERC)” in the Hong Kong Science and Technology Parks, supported and congratulated by **Mr. Nicholas Wei-Hsiung Yang**, Secretary for Innovation and Technology Bureau, and **Ms Annie Choi**, Commissioner for Innovation and Technology of the Government of the Hong Kong Special Administrative Region.
Mr. Wan Gang, Head of Ministry of Science and Technology, the People’s Republic of China, together with Mr. Nicholas Wei-Hsiung Yang, Secretary for Innovation and Technology Bureau, and Ms Annie Choi, Commissioner for Innovation and Technology of the Government of the Hong Kong SAR, taking a photo with Presidents of Universities in Hong Kong, Directors of Partner Key State Laboratories of Hong Kong and Directors of Chinese National Engineering Research Centers.
Office Bearers:

Prof. K. F. Chung
Director

Prof. Michael C. H. Yam
Deputy Director &
Secretary General

Prof. Joseph Y. W. Mak
Chief Engineer

Dr. T. M. Chan
Deputy Secretary General

Dr. H. C. Ho
Deputy Secretary General

Ir Victor W. H. Wu
Senior Project Fellow

Dr. Andy Y. F. Leung
Assistant Professor
Overview

CNERC for Steel Construction (Hong Kong Branch)

Development Bureau
Construction Industry Council
Chinese National Engineering Research Centre
for Steel Construction
Chinese Iron and Steel Association

Promoting sustainable infrastructure development in Hong Kong

Promoting export of Hong Kong and Chinese Steel Construction Industry

Promoting advanced structural engineering technology in modern steel construction
1.1 Establishment

The CNERC has moved into Room Z106 since July 2017 with a total space of about 150m² in Z-Block, The Hong Kong Polytechnic University, which is now accommodating about 20 research and administrative staff.

CNERC Office:
Laboratories:

Structural Engineering Research Laboratory (Laboratory Y001)

Building Technology Laboratory (Laboratory ZB207)
Laboratories:

Welding Laboratory (Laboratory W001)

Robotic Welding System Fanuc ARC Mate 100iC
1.2 Human resources

Key personnel for research and development projects:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Position</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Prof. K. F. Chung</td>
<td>Director</td>
</tr>
<tr>
<td>2</td>
<td>Prof. Michael C. H. Yam</td>
<td>Deputy Director and Secretary General</td>
</tr>
<tr>
<td>3</td>
<td>Dr. T. M. Chan</td>
<td>Deputy Secretary General</td>
</tr>
<tr>
<td>4</td>
<td>Dr. H. C. Ho</td>
<td>Deputy Secretary General</td>
</tr>
<tr>
<td>5</td>
<td>Ir Victor W. H. Wu</td>
<td>Senior Project Fellow</td>
</tr>
<tr>
<td>6</td>
<td>Prof. Joseph Y. W. Mak</td>
<td>Chief Engineer</td>
</tr>
<tr>
<td>7</td>
<td>Prof. Albert P. C. Chan</td>
<td>Head (BRE)</td>
</tr>
<tr>
<td>8</td>
<td>Prof. Tarek Zayed</td>
<td>Professor (BRE)</td>
</tr>
<tr>
<td>9</td>
<td>Prof. Asif Usmani</td>
<td>Head (BSE)</td>
</tr>
<tr>
<td>10</td>
<td>Prof. S. C. Poon</td>
<td>Chair Professor (CEE)</td>
</tr>
<tr>
<td>11</td>
<td>Prof. S. L. Chan</td>
<td>Chair Professor (CEE)</td>
</tr>
<tr>
<td>12</td>
<td>Prof. J. G. Dai</td>
<td>Professor (CEE)</td>
</tr>
<tr>
<td>13</td>
<td>Dr. Y. Dong</td>
<td>Assistant Professor (CEE)</td>
</tr>
<tr>
<td>14</td>
<td>Dr. Andy Y. F. Leung</td>
<td>Assistant Professor (CEE)</td>
</tr>
<tr>
<td>15</td>
<td>Dr. Calvin Luk</td>
<td>Project Manager (DISI)</td>
</tr>
<tr>
<td>16</td>
<td>Prof. Kenneth K. M. Lam</td>
<td>Professor (EIE)</td>
</tr>
<tr>
<td>17</td>
<td>Dr. H. W. Wai</td>
<td>Associate Director (IC)</td>
</tr>
<tr>
<td>18</td>
<td>Dr. Z. B. Jiao</td>
<td>Assistant Professor (ME)</td>
</tr>
<tr>
<td>19</td>
<td>Dr. David Navarro-Alarcon</td>
<td>Assistant Professor (ME)</td>
</tr>
</tbody>
</table>

Personnel for Administration:

<table>
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<tr>
<th>No.</th>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Miss Catherine Ng</td>
<td>Executive Officer</td>
</tr>
</tbody>
</table>
1.3 Financial status

Financial Status of the CNERC from 01/01/2018 to 31/12/2018:

- **Budget:** $10.0 M
  - ITC $5.0 M
  - PolyU $5.0 M

- **Expenses:** $10.0 M
  - Manpower: $4.0 M
  - Equipment: $1.5 M
  - General Expenses: $0.5 M
  - Research Projects: $4.0 M

Major purchase of equipment:

Intelligent Welding Robot (Purchased in 2015: HK$0.92M)

A digital image correlation system (Purchased in 2016: HK$0.74 M)

A 500 kN multi-functional tension/compression testing system (Purchased across 2016-2017: HK$3.2 M)

A Wind Suction Test Chamber (Purchased in 2017: HK$0.3M)
2. Research activities and achievements

2.1 Work Theme A - Sustainable Infrastructure Development

The CNERC will conduct high impact research and develop suitable design recommendations for implementation by Hong Kong Construction Industry. These new recommendations are of paramount importance for durability assessment on existing structures as well as durability design of new structures in Hong Kong as well as in neighbouring cities in the Pearl River Delta Region.

2.2 Work theme B: Structural engineering on modern steel construction

The CNERC is also promoting sustainable infrastructure development for the construction projects in Hong Kong as well as in overseas through effective use of high performance constructional materials, in particular, of high strength steel materials produced in China. Owing to the lack of proven design methods.
### 2.3 Details of research and development projects

<table>
<thead>
<tr>
<th>Project Title</th>
<th>PI</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work Theme A  Sustainable infrastructure development</strong></td>
<td></td>
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<tr>
<td>A1    Atmospheric corrosivity on infrastructure development</td>
<td></td>
<td></td>
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<tr>
<td>a)   Atmospheric corrosivity of exposed structural steelwork</td>
<td>K. F. Chung</td>
<td>36</td>
</tr>
<tr>
<td>A2    Localized corrosion in galvanized steel reinforcements in reinforced concrete structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)   Corrosion mechanisms and prevention of high performance steel in reinforced concrete structures</td>
<td>C. S. Poon</td>
<td>36</td>
</tr>
</tbody>
</table>
### 2.3 Details of research and development projects

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<tr>
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<tbody>
<tr>
<td><strong>Work Theme B  Structural engineering on modern steel construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1 Effective use of high performance steel materials – Q690 ~ Q960</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Effective high strength steel construction for sustainable infrastructure development in Hong Kong</td>
<td>K. F. Chung and H. C. Ho</td>
<td>36</td>
</tr>
<tr>
<td>b) Advanced numerical analyses for building structures using high performance steel materials</td>
<td>S. L. Chan</td>
<td>24</td>
</tr>
<tr>
<td>c) Effective use of high performance steel materials – Q690 to Q960</td>
<td>C. H. Yam</td>
<td>36</td>
</tr>
<tr>
<td>B2 Application of high performance steel materials Q690 to Q960 in super high-rise commercial buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Structural optimization of super high-rise commercial buildings using high performance Q690 to Q960 steel materials</td>
<td>K. F. Chung and W. H. Lau</td>
<td>24</td>
</tr>
<tr>
<td>b) Blind-bolted end-plate to concrete-filled tubular connections using high strength materials</td>
<td>T. M. Chan</td>
<td>36</td>
</tr>
<tr>
<td>c) Welding machine monitoring system</td>
<td>K. M. Lam and Victor Wu</td>
<td>24</td>
</tr>
<tr>
<td>B3 International practice on engineering design and management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Marketing strategies for the development of the steel industry in Hong Kong</td>
<td>P. C. Chan</td>
<td>18</td>
</tr>
<tr>
<td>b) Vibration measurement and modal identification of standing seam metal roofing system and their applications in model updating of the clip stiffness</td>
<td>K. F. Chung and H. F. Lam (CityU)</td>
<td>24</td>
</tr>
<tr>
<td>B4 International visibility of Chinese Steel Construction Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>International conferences and symposia on advanced structural engineering in modern steel construction, and annual seminars</td>
<td>K. F. Chung and Joseph Mak</td>
<td>36</td>
</tr>
</tbody>
</table>
2.4 Professional publications

- **Professional Guide on “Selection of Equivalent Steel Materials to European Steel Materials Specifications”**
- **Technical Guide on “Effective Design and Construction to Structural Eurocodes: EN 1993-1-1 Design of Steel Structures”**
- **Professional Guide on “Design of Buildings and Structures in Low to Moderate Seismicity Regions”**
- **Technical Guide on “Introduction to Chinese Steel Construction Industry: Steel production and technical specifications”**
- **Marketing Strategies for Development of Steel Construction in Hong Kong**
2.5 Code Drafting

In addition to the abovementioned professional publication work, the CNERC has also participated in different editorial work together with the Hong Kong Constructional Metal Structures Association, including:

a) In April 2018, the Hong Kong Constructional Metal Structures Association participated in the preparation of the local standard "Steel Structure Construction and Quality Acceptance Regulations" of the Guangdong Steel Structure Association.

b) In September 2018, the CNERC was invited by China Construction Steel Co., Ltd. to participate in the China Engineering Construction Standardization Association Standard, namely “Steel Structure Engineering Deepening Design Regulations”.

c) In September 2018, the CNERC was also invited by the Guangdong Provincial Department of Housing and Urban-Rural Development to participate in two new standards, namely, i) “Design and Construction of Built-up Metal Roofs in Strong Wind Zones” jointly compiled by the South China University of Technology and Guangdong Baianli Light Steel Structure Products Co., Ltd., ii) “Technical Regulations and Performance Testing and Appraisal of Metal Systems in Strong Wind Areas” jointly compiled by South China University of Technology and Guangdong Academy of Building Science Group Co., Ltd.

d) In October 2018, the CNERC was invited by Building Structure Standardization Committee of the Ministry of Housing and Urban-Rural Development to participate in the industry standard for building industrial products, namely, "Technical Standards for Prefabricated Aluminum Low-rise Buildings and Mobile Homes".
3. Research and development of Steel Construction

In order to promote effective steel construction in Hong Kong and beyond, the CNERC has been actively reaching out to industrial partners including construction companies, contractors, and relevant agencies etc. for collecting construction projects on iconic steel structures designed and constructed by Hong Kong engineers as well as by Chinese engineers to build up an online database. The database presents good examples of tall buildings and long span bridges designed and constructed by Hong Kong engineers as well as Chinese engineers, and to demonstrate high levels of professional achievements in steel construction. The relevant completed projects can now been seen at our website:

Hong Kong Engineering:

Chinese Engineering:
3.1 Academic exchanges
The CNERC has attended and organized a number of academic exchanges since 2015. Some of the major events included:

International Conference on Engineering Research and Practice for Steel Construction 2018 (5 to 7 September 2018)

A total of 10 world-renowned researchers and engineers presented their recent research works and construction projects during their keynote lectures, and 20 sessions including 13 special sessions with over 100 technical papers were presented over the three-day event.
International Symposium on Advances in Steel and Composite structures 2015  
(27 November 2015)

International Symposium on Advances in Steel and Composite Structures 2016  
(6 December 2016)

International Symposium on Advances in Steel and Composite Structures 2017  
(24 November 2017)

CNERC Research & Development Meeting (19 February 2016)  
presentation by Prof. Alex P. K. Wai,  
Vice President (Research Development) of the PolyU
International Symposium on Design of Steel & Composite Structures in accordance with Eurocodes (25 August 2017)


ISructE China Young Researchers’ Conference 2017 (23 December 2017)

International Top-Level Forum on Engineering Science and Technology Development Strategy (19 to 21 October 2018)
3.2 Industrial exchanges

The CNERC has conducted a number of industrial exchanges both inbound and outbound to learn the latest development on various aspects of steel construction. Some of the key events included:

- Technical visit to Singapore (26 to 30 July 2016)
- Meeting with Development Bureau The Government of Hong Kong SAR (21 December 2016)
- Official visit to Beijing (8 September 2016)
Official visit to Beijing
(9 September 2016)

Visit by Ms. Annie Choi, Commissioner,
Innovation and Technology Commission
(26 October 2016)

The 11th Pacific Structural Steel Conference
(29 to 31 October 2016)
Establishment of Steel Construction and Fabrication Committee
(March 2017)

Meeting with Urban Renewal Authority, Hong Kong SAR
(20 April 2017)

Official visit to Shenyang and Anshan
(28 to 30 July 2017)

Fourth Forum on Innovation on Architecture and Civil Engineering
Changsha, China
(22 to 24 September 2017)
MOU signing ceremony on collaboration of steel construction engineering research
(24 November 2017)

Visit by Shougang Group
(27 November 2017)
Official visit to Beijing
Meeting with Prof. W. Huang, Vice Minister of
Ministry of Science and Technology (MOST) reporting on
the latest research and achievements of CNERC
(15 to 17 January 2018)

MOU signing ceremony
Signed a MOU with Shougang Group and several Chinese
national research institutes
(2 April 2018)

Technical visit to Beijing
Meeting with China Construction Science & Technology Group
(13 to 14 November 2018)
CNERC received PTeC’s Outstanding Professional Services Awards 2017 (2 March 2018)

Visit by Ir C. K. Hon, JP Permanent Secretary for Development (Works), Development Bureau of the Government of Hong Kong SAR (20 April 2018)

Visit by Ir Albert Cheng, Executive Director of Construction Industry Council, and Ir C. C. Chan, Ex-Director of Drainage Services Department (30 May 2018)

Prof. K. F. Chung was invited to attend a luncheon hosted by Mrs. Carrie Lam, Chief Executive of Government of Hong Kong SAR at the Government House (13 June 2018)
Visit by Ir Dr the Hon Lo Wai Kwok, SBS, MH, JP, Member of Legislative Council of the Hong Kong Special Administrative Region (20 March 2018)

Meeting with Mr. T. N. Tan, Deputy Director of the Central Government Liaison Office (6 September 2018)

Meeting with Mr. Z. G. Wang, Minister of Science and Technology of the PRC China (20 September 2018)
3.3 Training

Working closely with the Education and Training Committee of the Hong Kong Constructional Metal Structures Association, a number of training activities such as technical seminars and symposia have been organized and supported by the CNERC. Over a thousand of engineers from public and private sectors attended these events over the past years.

Technical Seminar on Effective Design and Construction to Structural Eurocodes
(24 June 2016 with an attendance of about 80 engineers)

International Symposium on Advances in Steel and Composite Structures 2016
(6 December 2016 with an attendance of about 160 engineers)
Technical Seminar on Effective Design and Construction to Structural Eurocode 3: BS EN 1993-1-1: Design of Steel Structures (29 September 2017 and 27 October 2017 with a total attendance of over 200 engineers)

International Symposium on Advances in Steel and Composite Structures 2017 (24 November 2017 with an attendance of over 130 researchers, scholars and engineers)
Technical Meeting on Effective Use of High Performance Q690 Steel Materials in building construction
(2 September 2016 with an attendance of about 80 engineers)

A CPD Seminar entitled “Steel Frame Construction in Hong Kong: Threats and Opportunities”
(31 May 2017 with an attendance of over 150 participants)
International Conference on Engineering Research and Practice for Steel Construction 2018

4. Contributions


In response to President Xi Jinping’s important instruction on enhancing cooperation in science and technology between the Hong Kong Special Administrative Region (HKSAR) and the Mainland, Prof. K. F. Chung received numerous media interviews on 16 May 2018 in this regard.
4.1 Belt and Road Initiative

Since its establishment in 2015, the CNERC has been actively developing the following strategies to support the Initiative:

a. People-to-people connection
   The CNERC has sent various delegation teams to visit the following Belt and Road countries for both technical and professional exchanges: Vietnam, Singapore, Portugal. It has received many delegations in return in the last three years.

b. Use of Chinese steel materials in overseas construction projects

c. Infrastructure development against seismic actions

d. International visibility and contributions to national & local media
4.2 Greater Bay Area Development

Development for Wind Resistant Design of Metal Building Envelopes in the Greater Bay Area (GBA)

Signing of “Collaborative agreement on design development for wind resistant design of metal building envelopes in the Greater Bay Area”.

4.3 Collaboration with CNERC-BJ

The CNERC has been actively collaborating with the Chinese National Engineering Research Centre for Steel Construction (CNERC-BJ) since its establishment. The support from Prof. Qingrue Yue, President of CNERC to our work over the past years is highly appreciated. It should be noted that the CNERC is administrated under the Chinese Metallurgical Construction Research Institute (CMCRI), and Prof. Q. R. Yue is also President of CMCRI.

The CNERC and the CNERC-BJ signed a MOU to develop specific technological collaborations (1 August 2016)

The CNERC delegation team and Prof. Q. R. Yue attended the Annual National Steel Structures Conference jointly organized by the Chinese Steel Construction Association, and CNERC in Hangzhou (6 November 2017)

Prof. K. F. Chung attended the Annual Meeting of Sino-Japanese Steel Construction organized by CNERC-BJ and CMCRI. Prof. Q. R. Yue presented a report entitled “The Current Status and Challenges Facing by the Chinese Steel Structure Industry” (17 January 2018)

Meeting with CNERC-BJ for Engineering Research Collaboration (8 September 2016)

Prof. K. F. Chung, Prof. Q. R. Yue, and Prof. Alex Wai attended the Forum on Mainland-Hong Kong Cooperation in Innovation and Technology at the Central Government Offices in Tamar (15 May 2018)
Collaborative work with CNERC-BJ

The CNERC has developed the following research and development projects with CNERC-BJ together with a number of collaborators in the past few years, and these collaboration work are summarized as follows:

➢ Research and Development Project:
Title: Developing a modern profiled steel decking with corrosion and fire resistant steel
Collaborative partners: CMCRI, Tsinghua University, Shougang Research Institute of Technology, CNERC, P & L Building Materials
Aims: To develop composite slabs with profiled steel decking using corrosion and fire resistant steel for high-rise steel-concrete composite buildings in China and overseas

➢ Code drafting
Title: Code of Practice for Metal Building Envelopes in Strong and Frequent Winds Regions
Chief Editor: Mr. Qigong Xu, GuangDong Architectural Design and Research Institute
Aims: To draft a provincial code of practice in wind design for buildings and structures in Guangdong together with 23 experts, researchers and academics in China, Hong Kong and Taiwan.

Title: Code of Practice for Composite Design in Buildings and Structures
Chief Editor: Prof. Zhaoxin Hou, Chief Engineer, CNERC-BJ
Aims: To draft a national code of practice in composite design for high-rise steel-concrete composite buildings together with over 36 experts, researchers and academics in China.
Collaborations and MOUs

Over the past 3 years, CNERC collaborated actively with the industry and institutions, and many technical agreements and MOUs were signed.
5. Conclusions

The CNERC is dedicated to promote technological advancement and internationalization of both Hong Kong Construction Industry and Chinese Steel Construction Industry and actively engages with international as well as national exchanges in research and development of steel construction. The Industrial Collaborators of the CNERC are Development Bureau of the Government of Hong Kong Special Administrative Region, and the Construction Industry Council in Hong Kong.

Some of the major activities are summarized as follows:

➢ The CNERC has engaged with various parties for collaboration, and the followings are major collaborations taken place this year:

• A technical agreement on engineering application of new steel materials was signed among the CNERC, Tsinghua University, Shougang Group, China Metallurgical Group Corporation and P&L Co. Ltd. on 2 April 2018.

• A MOU on establishment of CNERC-AluHouse Laboratory for Modular Integrated Construction was signed with AluHouse Co., Ltd. on 5 September 2018.

• A technical agreement on engineering research of metal roof systems was signed with China Construction Steel Structure Corp. Ltd. on 3 December 2018.

• A MOU on establishment of a joint research laboratory was signed with Shougang Group on 8 December 2018.
The CNERC also engaged the Hong Kong Constructional Metal Structures Association Limited (HKCMSA) to sign collaborative agreements with various parties for research related activities in the industry:


• In September 2018, the CNERC was invited by China Construction Steel Co., Ltd. to participate in code drafting of a design standard entitled “Steel Structure Engineering Deepening Design Regulations” of China Engineering Construction Standardization Association.

• In September 2018, the CNERC was also invited by the Guangdong Provincial Department of Housing and Urban-Rural Development to participate in drafting of two new standards: i) “Strong Wind Zone Metal Roof and Wall Systems” jointly edited by South China University of Technology and Guangdong Baianli Light Steel Structure Products Co., Ltd., ii) “Technical Regulations and Performance Testing and Evaluation of Metal Wall Systems in Strong Wind Areas”, jointly edited by South China University of Technology and Guangdong Academy of Building Research Group Co., Ltd.

• In October 2018, the CNERC was invited by Building Structure Standardization Technical Committee of the Ministry of Housing and Urban-Rural Development to participate drafting of a product standard entitled "Technical Standard for Prefabricated Aluminum Alloy Low-rise Buildings and Mobile Homes".

• A collaborative agreement on wind resistant design for Guangdong-Hong Kong-Macao Greater Bay Area was signed by HKCMSA with Guangdong Academy of Building Research Group Co. Ltd. on 25 November 2018.

The State Ministry of Science and Technology commissioned the CNERC with a research funding at RMB1.0M to carry out the research and development project entitled “Promoting effective use of quality Chinese steel materials for construction projects overseas”.
