CNERC
NEWSLETTER
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MAY - AUG 2024

FEATURE STORY

First Meeting of Expert Committee of Technical Group Standard on "Design standard for structures using high-strength 690 to 960 MPa steel" of China Steel Construction Society

CNERC was invited by China Steel Construction Society (CSCS) to draft a *Technical Group Standard* entitled "Design standard for structures using high strength 690 to 960 MPa steel" for the China Steel Construction Industry owing to the success of CNERC in receiving the Grand Award of the "**CSCS Science and Technology Awards 2022**". This important initiative was endorsed by the China Steel Construction Society in December 2023, and the Standard was expected to be completed in 2025.

Expert Committee of CSCS *Technical Group Standard*
"Design standard for structures using high-strength 690 to 960 MPa steel"

On 16 May 2024, the Expert Committee of the CSCS *Technical Group Standard* was officially established at The Hong Kong Polytechnic University with the following members:

Principal drafters

- Prof. K. F. CHUNG — The Hong Kong Polytechnic University
- Prof. Yongjiu SHI — Tsinghua University
- Dr. H. C. HO — The Hong Kong Polytechnic University
- Dr. Huiyong BAN — Tsinghua University
- Dr. Y. F. HU — The Hong Kong Polytechnic University
- Prof. Michael C. H. YAM — The Hong Kong Polytechnic University
- Prof. T. M. CHAN — The Hong Kong Polytechnic University

Experts - China

- Prof. Fulin ZHOU — Guangzhou University
- Prof. Ailin ZHANG — Beijing University of Civil Engineering and Architecture
- Prof. Mingxuan HE — China Baowu Steel Group Corp.
- Mr. Lijun WANG — Beijing Long'an Huacheng Consulting Co., Ltd.
- Prof. Zhan WANG — South China University of Technology
- Mr. Tie XI — Hebei Jinxi Iron and Steel Group Co., Ltd.
- Mr. Baowei DANG — China Construction Industry Association (Steel and Wooden Structures Branch)
- Mr. Zhipan ZENG — Fujian Provincial Institute of Architectural Design and Research Co., Ltd.
- Prof. Yuyin WANG — Harbin Institute of Technology
- Mr. Linyin XIA — China State Construction Engineering Corporation
- Prof. Lu YANG — Beijing University of Technology
- Prof. Fei XU — Chongqing University
- Prof. Yanbo WANG — Tongji University
- Prof. Ke KE — Chongqing University
- Prof. Liang ZONG — Tianjin University
- Prof. Xuanding WANG — Chongqing University
- Prof. Mingxiang XIONG — Guangzhou University
- Prof. Cheng CHEN — Southwest Petroleum University
- Prof. Fangxin HU — South China University of Technology
- Mr. Gaoyang YANG — China State Construction Engineering Corp.
- Dr. Juan WANG — CapitaLand Co., Ltd.

Experts – Hong Kong

- Jun KAN — China Road and Bridge Corp.
- Alex KWAN — Asian Infrastructures Solution
- Xianjun DUAN — Beijing City Construction Group
- H. Y. LEE — Hong Kong Constructional Metal Structures Co., Ltd.
- C. F. CHAN — Gammon
- K. L. WONG — AECOM
- William LUK — Chun Wo

Experts – Representatives of steel fabricators

- L. F. MA — Zhenhua Port Machinery Company
- L. Y. XIA — China Construction Steel Structure
- J. L. LIU — Jinqiang Steel Structure
- C. C. HAU — Gammon
- Y. H. NG — TTJ Singapore
- Patrick YAN — Yau Sang

The First Meeting of the Expert Committee was held in the morning of 16 May 2024 at The Hong Kong Polytechnic University, and it was hosted by Prof. K. F. Chung, Director of CNERC, and Dr. Y.F. Hu, Research Assistant Professor of CNERC. A total of 28 experts from China and Hong Kong, and 6 representatives from steel fabricators from Shanghai, Shenzhen, Fuzhou, Hong Kong and Singapore were present.

Prof. K. F. Chung introduced the background of the Standard and its potential applications in construction in China. Key challenges in design philosophy and materials specifications during drafting of the Standard were also presented. A comprehensive comparison on structural design of high strength steel structures among GB 50017, JGJ/T 483 and EN 1993-1 was presented by Dr. Y.F. Hu, in particular, various design philosophy and rules as well as differences in material specifications of high strength steel. It should be noted that Prof. Y.J. Shi reported to the Expert Committee about the work of JGJ/T 483, and highlighted key achievements achieved in JGJ 483, and also subsequent development in structural steel design of high strength steel which were specified in GB/T 1591 and GB/T 19879. A number of experts also expressed their suggestions to the proposed scope and the proposed methodology of the Standard as follows:

a) It is important to follow the design philosophy of "strong columns and weak beams" in seismic structural design of structures in China. One of the practical design approach is the use of elastic design of columns, and all these columns should use S690 steel columns. For beams, the use of S355 and S460 steel will be appropriate. Moreover, no high strength S690 steel should be adopted in energy dissipating zones in structural systems. Instead, S355 steel should be used.

b) The Global Elastic Analysis approach is considered to be highly effective in structural design of high strength S690 steel structures. When compared with S355 steel, the use of S690 steel gives an increase in both yield strengths and section resistances with a factor of about 2.0. In order to mobilize the full moment resistances of typical I-sections through plastic section design, the moment resistances of these sections will be increased by a factor 1.15 to 1.20.

   It is important to note that by adopting the use of high strength S690 steel through the Global Elastic Analysis approach, a significance increase in the section resistances is readily achieved. This is straightforward, and non-controversial, and hence, the Global Elastic Analysis should be adopted for practical design immediately. Nevertheless, the use of the Global Plastic Analysis should also be examined, and its adoption should be explored once sufficient technological development has been taken place.

c) In China, there is a requirement in all structural steel to possess a certain ductility in seismic resistant structures, and this requirement is specified as a limiting value for the yield to tensile strength ratio, i.e. f_y / f_u , to be equal to or smaller than 0.85. While this value is readily achieved in S355 steel, no existing high strength S690 steel is able to satisfy this requirement.

   It should be noted that this requirement is generally considered to be a requirement on materials, and the ratio is not used in structural design at all in assessing seismic resistances of steel members and systems. It is considered to be rational to re-examine the significance of this ratio, and explore possibilities of increasing the value to 0.90, and even further to 0.95, as those values adopted in European steel material specifications EN 10025.

d) Owing to the imminent requirement to provide seismic isolation to all new building structures in regions with Seismicity Levels 7 and 8 in China, this allows the use of high strength S690 steel in these seismic isolated structures readily.

In the afternoon, experts visited the Structural Engineering Research Laboratory of PolyU, and Welding Laboratories of CNERC.

By dusk, experts visited the Cross Bay Link in Tseung Kwan O both on a coach crossing the Double Arch Steel Bridge, and on foot from afar to see the beautiful structure of the Steel Bridge.

A group photo in front of the Cross Bay Link, Tseung Kwan O
A total of 4,400 tons S690QL high strength steel were used in the Steel Bridge. The project was completed in December 2023, and it was open to the public since then.

On 17 May 2024, a Technical Seminar entitled "*Effective Use of High Strength Steel S690 in Construction*" was held in a hotel in the TST East area by CNERC and Hong Kong Constructional Metal Structures Association. All the Mainland and the local experts and representatives of steel fabricators were also invited to attend the Technical Seminar. The event was supported by Development Bureau of the Government of Hong Kong SAR, and the Construction Industry Council.

The Technical Seminar was organized as a platform for to disseminate research findings and experiences on advanced construction technology of high strength S690 steel with special emphases on practical applications. It also served as a focal point for renowned engineers to share experiences in adopting high strength S690 steel in their construction projects. It was attended by about 250 engineers, 16 Experts from the Mainland China, 8 Experts from Hong Kong, and another 6 representatives from steel fabricators.

Ir Ricky C. K. Lau, Permanent Secretary for Development (Works) of the Government of Hong Kong SAR was invited as Guest of Honour to give an Opening Speech, and Prof. Christopher Chao, Vice President (Research & Innovation) of The Hong Kong Polytechnic University was invited to give a Welcoming Speech.

A photo of honorable guests: Hon. Andrew S. L. Lam, Hon. Duncan Chiu, Hon. Dr. W. K. Lo, Prof. K.F. Chung, Ir Ricky Lau, Prof. Chris Chao, Mr. C. S. Wai, and Ms. Clarice Yu

Honorable Guests and Mainland Experts

Honorable Guests and Local Experts

Honorable Guests and Representatives of Steel Fabricators

The event was attended by about 300 engineers and experts

Prof. K. F. Chung, Director of CNERC

NEWS

Technical Seminar on Effective Use of High Strength Steel S690 in Construction

CNERC and Hong Kong Constructional Metal Structures Association jointly organized a Technical Seminar entitled "*Effective Use of High Strength Steel S690 in Construction*" on 17 May 2024 in a hotel in the TST East area. Moreover, the event was supported by Development Bureau of the Government of Hong Kong SAR, and the Construction Industry Council.

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Ir Ricky C. K. Lau

Prof. Christopher Chao

Honorable Guests and Invited Speakers of the Technical Seminar

The Opening Ceremony of the Technical Seminar was attended by a number of honorable guests including:

- Ir. Ricky C. K. Lau, Permanent Secretary for Development (Works)
- Dr. Hon W. K. Lo, Member of Legislative Council
- Hon Duncan Chiu, Member of Legislative Council
- Hon Andrew S. L. Lam, Member of Legislative Council
- Mr. C. S. Wai, Executive Director of Urban Renewal Authority
- Ms. Clarice Yu, Director of Buildings Department
- Mr. Harry Ma, Deputy Director of Civil Engineering and Development Department
- Mr. Andy C. C. Lok, Assistant Director, Water Supplies Department
- Mr. Joseph Chung, Deputy Project Manager, Highways Department
- Mr. Dennis Wan, Government Engineer/Railway Development, Highways Department
- Dr. Rocky Cheng, CEO of Hong Kong Cyberport

The event was attended by about 300 engineers and experts

Programme

9:00 am	**Opening Ceremony** ***Welcoming Speech*** *by* **Prof. Christopher Chao, Vice President (Research & Innovation)** ***Opening Speech*** *by* **Ir Ricky C. K. Lau, Permanent Secretary for Development (Works)**
9:40 am **Presentation 1**	**High strength S690 steel and their benefits in construction** *by* K. F. Chung, H. C. Ho and Y. F. Hu
10:10 am **Presentation 2**	**An inspiring Hong Kong landmark - Two iconic new arch bridges in Tseung Kwan O - Cross Bay Bridge and Promenade Southern Bridge - Pioneering with Grade S690QL high strength structural steel** *by* Michael C. L. Leung and Robin S. H. Sham
10:40 am	*Coffee Break*
11:10 am **Presentation 3**	**Circularity in construction - Recommendations for implementing a circular economy in construction: Direct reuse approach of steel structures** *by* T. M. Chan
11:40 am **Presentation 4**	**Effects of fabrication to structural behaviour of high strength S690 steel members, connections and joints** *by* Y. F. Hu and K. F. Chung
12:10 pm	***Lunch***
2:00 pm **Presentation 5**	**Pilot Use of High Strength S690 Steel in Redevelopment of Kowloon Tsai Swimming Pool Complex** *by* Ken Y.C. Ho
2:30 pm **Presentation 6**	**Design and construction of high strength S690 steel members and connections** *by* H. C. Ho and K. F. Chung
3:00 pm **Presentation 7**	**Design of high strength S690 steel piles in building structures** *by* K. L. Wong and Rosaline B. K. Lau
3:30 pm	*Coffee Break*
4:00 pm **Presentation 8**	**Innovative SMA-based connections for seismic resilience** *by* Michael C. H. Yam
4:30 pm **Presentation 9**	**Innovations in pile instrumentation technologies and investigation on pile-ground interaction effects** *by* Andy Y. F. Leung
5:00 pm	***End***

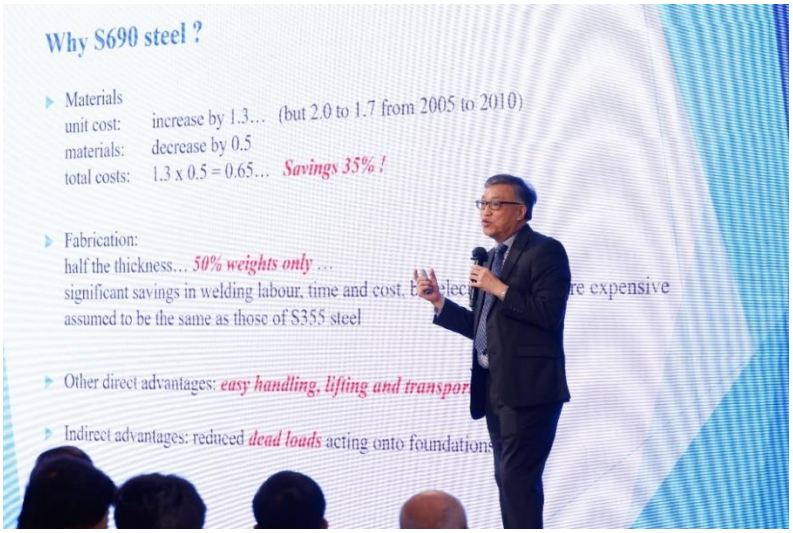
It should be noted that the Expert Committee of Technical Group Standard entitled “Design standard for structures using high-strength 690 to 960 MPa steel” of China Steel Construction Society was officially established at The Hong Kong Polytechnic University on 16 May 2024. All the Mainland China and the local experts and representatives of steel fabricators were invited to the Technical Seminar.

Honorable Guests and Mainland Experts

Honorable Guests and Local Experts

Honorable Guests and Representatives of Steel Fabricators

To kick off the Technical Seminar, Prof. K. F. Chung gave a presentation on “High strength S690 steel and their benefits in construction”.



Prof. K. F. Chung, Direct of CNERC

After that, Ir Michael C. L. Leung of CEDD and Dr. Robin Sham of AECOM gave a presentation entitled “An inspiring Hong Kong landmark - Two iconic new arch bridges in Tseung Kwan O - Cross Bay Bridge and Promenade Southern Bridge - Pioneering with Grade S690QL high strength structural steel”.

Ir Michael C. L. Leung, CEDD

Dr. Robin Sham, AECOM

Honorable Guests and CNERC Office Bearers and Research Team

NEWS

The 2nd National Academic Symposium and Technical Conference of the Inspection, Evaluation, Reinforcement, and Modification Branch of the China Metal Structure Association

The 2nd National Academic Symposium and Technical Conference of the Inspection, Evaluation, Reinforcement, and Modification Branch of the China Metal Structure Association (IERMC-2024), hosted by the China Metal Structure Association, was held from 1 – 3 August 2024, in Chengdu, China. This conference focused on "New Methods, New Technologies, New Developments, and New Applications in the Inspection, Evaluation, Reinforcement, and Modification of Engineering Structures." Over 400 researchers and graduate students participated, engaging in comprehensive and multifaceted academic discussion on the theories and technologies related to engineering structure inspection, evaluation, reinforcement, and modification. Prof. K. F. Chung, Director of CNERC, Assistant Professor (Research) Dr. Y. F. Hu, and Postdoctoral Research Fellow Dr. M. F. Zhu were invited to attend.

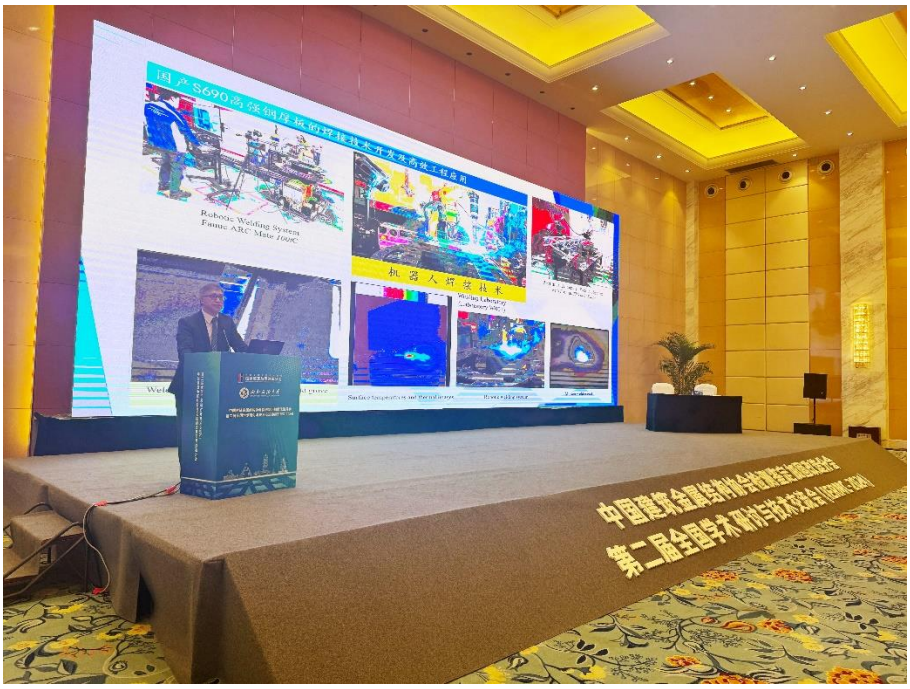
Group photo of the conference

(From left): Dr. Y. F. Hu, Prof. Y. B. Shao and Prof. K. F. Chung

(From left): Dr. Y. F. Hu, Prof. G. Shi and Prof. K. F. Chung

In the afternoon of 2 August 2024, Prof. K. F. Chung was invited to give a keynote speech "Design and Engineering Application of 690 MPa High Strength Steel Structures." He shared the development journey of the CNERC with the audience. Over the past decade, the team of CNERC has conducted extensive investigations on 690 MPa high strength steel structures, focusing on the steel material, mechanical properties, microstructure, welding techniques, and structural performance. These efforts have facilitated the application of high strength steel in several practical engineering projects in Hong Kong and Mainland China, including the Tseung Kwan O Cross Bay Link Steel Bridge and the Yuen Long Sports Centre which under construction

Prof. Chung gave a keynote speech titled "Design and Engineering Application of 690 MPa High Strength Steel Structures"



The organizing committee presented a certificate and a souvenir to Prof. K. F. Chung

On 1 August 2024, with the invitation of Dr. C. Chen from Southwest Petroleum University, Prof. K. F. Chung and his team visited the Department of Civil and Environmental Engineering at Southwest Petroleum University. They had a meeting with Prof. G Dan, the Dean of the Department of Civil and Environmental Engineering and listened to academic reports from graduate students in Dr. C. Chen's research group. They discussed on issues such as fatigue corrosion and microstructure in the welded sections of EH690 steel. After the meeting, they also visited the Structural Engineering Laboratory of Southwest Petroleum University.

Prof. Chung, Dr. Hu, Dr. Zhu and Dr. C. Chen

NEWS

"Third Greater Bay Area Steel Structure Intelligent Construction and Construction Industrialization Technology Exchange Conference"

The "Third Greater Bay Area Steel Structure Intelligent Construction and Construction Industrialization Technology Exchange Conference" jointly organized by 36 units including the Professional Committee, China Steel Structure Association Welding and Connection Branch, China Welding Association Welding Equipment Branch, and sponsored by Guangdong Provincial Steel Structure Association, Hong Kong Construction Metal Structure Association, Macau Construction Industry Association, China Construction Steel Structure Co., Ltd., Guangdong Provincial Construction Engineering Green and Prefabricated Development Association Parts and Components Branch, Guangdong Hongwei International Exhibition Group Co., Ltd. Hosted by China Steel Structure Association Expert Committee, China Construction Metal Structure Association Steel Structure Expert Committee, China Engineering Construction Standardization Association Construction Robot Professional Committee, the Hong Kong Branch, China Steel Structure Association Intelligent Construction and New Building Industrialization, was held at Guangzhou Poly World Trade Expo Center .

Prof. K. F. Chung, Director of CNERC led his research team to visit the Engineering Seismic Research Center of Guangzhou University, and had an academic exchange with Prof. F. L. Zhou, Prof. Y. H. Ma, Prof. J. J. Luo, and W. Gong, all academicians of the Chinese Academy of Engineering, on the engineering application of 690 MPa high-strength steel, and discussed the material requirements and design methods of seismic isolation structures on 14 May 2024.

NEWS

Visit to Engineering Seismic Research Center of Guangzhou University

The CNERC's research team visited the Engineering Seismic Research Center of Guangzhou University, and had an academic exchange with Prof. F. L. Zhou, Prof. Y. H. Ma, Prof. J. J. Luo, and W. Gong, all academicians of the Chinese Academy of Engineering, on the engineering application of 690 MPa high-strength steel, and discussed the material requirements and design methods of seismic isolation structures.

NEWS

Annual Conference of Building Steel Structure Industry

Prof. K. F. Chung, Director of Hong Kong Branch attended the Annual Conference of Building Steel Structure Industry held in Jinan, and delivered a speech on "Structural Performance of High Strength 690 MPa Steel Structures under Advanced Manufacturing and Welding".

NEWS

Special issue for a column on "Engineering Application Research of Q690 High-Strength Steel Structure and Key Welding Technologies"

Prof. K. F. Chung, Director of CNERC was invited by the "Steel Construction" (Chinese and English) magazine as Chief Editor of a special issue for a column on "Engineering Application Research of Q690 High-Strength Steel Structure and Key Welding Technologies". In order to master the advanced concepts, scientific methods, key technologies and future development directions of the application process of high-strength steel structures in recent years, it took more than half a year to gather, review and finalize the papers, a total of 8 papers were successfully accepted and officially published on 31 May 2024.

NEWS

Departure of Prof. T. M. Chan, Deputy Director & Laboratory-in-charge of CNERC

With effect from 1 September 2024, Prof. T. M. Chan, Deputy Director & Laboratory-in-charge of CNERC had departed from PolyU for his future endeavors.

NEWS

Demonstration of effective use of high strength S960 steel

Prof. K. F. Chung was invited by Civil Engineering and Development Department (CEDD) of HKSAR to witness the effective use of high strength S960 steel - Footbridge Assembly Ceremony of CEDD's Fanling North New Development Area project held on 18 July 2024.

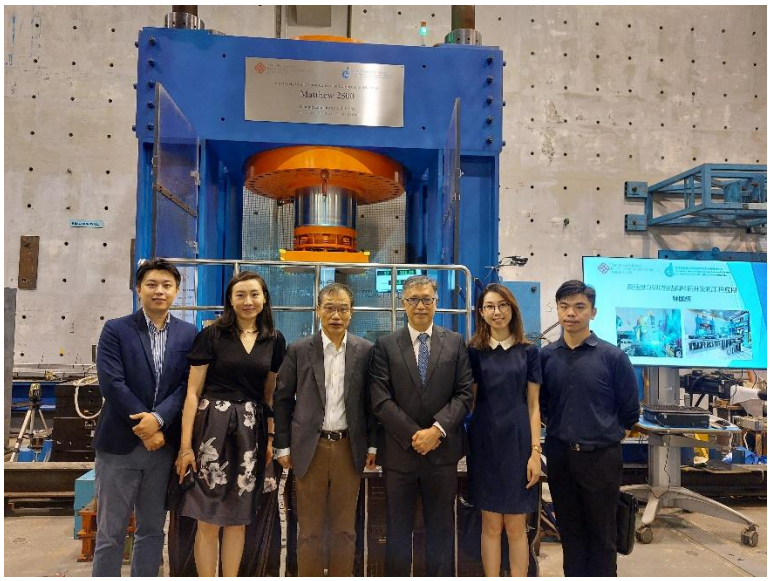
NEWS

CNERC Technical Seminar

A Technical Seminar on "Application of High Strength Friction Grip Bolts with Innovation Greenkote Advanced Coating" was organized by CNERC on 30 August 2024 in hybrid mode with a presentation by a research personnel of Department of Building and Real Estate then followed by a representative from J.A.M. Company in UK through online platform.

VISIT

Mr. Z. M. Liu, Inspector of the International Cooperation Department of the Ministry of Science and Technology, and Mr. P. He, General Manager of the New Industry Department of Shougang Holdings (Hong Kong) Co., Ltd., led the Shougang delegation team to visit CNERC on 17 July 2024.



Mr. C. K. Cheung, Executive Director of the One Country Two Systems Research Center and his team visited CNERC on 25 July 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.

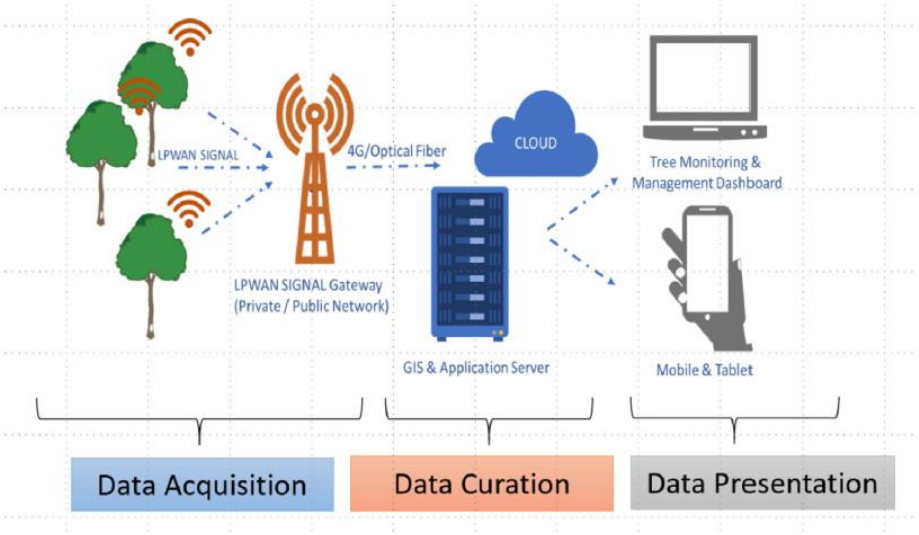
RESEARCH

Integration of atmospheric corrosion monitoring sensor with IoT technologies

Corrosion is a significant problem in infrastructure and industrial assets, causing structural damage, reducing operational efficiency, and increasing maintenance costs. Real-time monitoring of corrosion can prevent costly damage and improve maintenance scheduling. Traditional corrosion monitoring methods are often labor-intensive and require manual inspection of assets. Wireless sensors can be deployed to remotely monitor corrosion levels, making it more efficient and cost-effective.

The aim of this research is to integrate atmospheric corrosion monitoring sensors with cloud and wireless systems to enable real-time monitoring and analysis of corrosion levels. The objective is to improve the accuracy of corrosion predictions and to facilitate timely maintenance interventions. The proposed system can potentially reduce maintenance costs and improve the reliability of infrastructure and industrial assets.

To achieve the research aim, this project proposes the integration of atmospheric corrosion monitoring sensors with wireless systems and cloud platform. The system consists of a wireless sensor network, a cloud-based platform for data storage and analysis, and a data transmission technology such as LoRaWAN or NB-IoT. The wireless sensor network will consist of corrosion monitoring sensors placed at strategic locations on infrastructure and industrial assets. The sensors will measure corrosion levels and transmit the data to the cloud-based platform. The data will be analyzed to predict the corrosion rate and to identify any potential maintenance needs.



[1] Abbas, S., Kwok, C. Y. T., Hui, K. K. W., Li, H., Chin, D. C. W., Ju, S., Heo, J., Wong, M. S. (2020). Tree tilt monitoring in rural and urban landscapes of Hong Kong using smart sensing technology. Trees, Forests and People, 2, 100030. https://doi.org/10.1016/j.tfp.2020.100030.

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