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THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

土木及環境工程學系
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SEMINAR

PULTRUDED FIBER REINFORCED POLYMER PROFILES IN ENGINEERING: PRODUCTS, STRUCTURES, AND APPLICATIONS

Speaker

Prof. FENG Peng

Head of the Department of Civil Engineering, Tsinghua University

Abstract

Fiber Reinforced Polymer (FRP) pultruded profiles (hereinafter referred to as pultruded profiles) are composite materials produced by continuously pulling fiber bundles, fabrics, and felts through a process of resin impregnation, extrusion shaping, and heat curing, resulting in products with a consistent cross-section. Pultruded profiles are outstanding by their extraordinary lightweight, strength, and corrosion resistance, leading to extensive applications in engineering structures, such as bridges, cooling towers, wind turbine blades, solar panel brackets and bay windows. However, due to the unique properties of pultruded profiles, they still face challenges in three aspects: product production and evaluation, structural analysis and design, and engineering applications and standards.

For product production and evaluation, this work overcomes the limitations of traditional small-scale, straight-pultruded profiles, and producing large-scale, curved-pultruded profiles, which have been applied in practical engineering. Moreover, due to fiber misalignment, mold deformation, and uneven temperature distribution during the pultrusion process, initial defects such as non-uniform fiber-resin distribution and dimensions inaccuracies may occur. This study conducted experimental research to evaluate the impact of various initial defects and proposed a full-section compression test method to assess the influence of these defects. The related test methods have been adopted by the ISO international standard (ISO 23930:2023) and the Chinese national standard (GB/T 31539-2015).

For structural analysis and design, this study investigates the mechanical behavior, buckling performance, joint design methods, and deformation calculations of pultruded profile members under various loading conditions. Moreover, this study also established machine learning prediction models for the mechanical performance of pultruded profile members, capable of accurately predicting their load-bearing capacity and failure modes. This work has also developed long-term performance design methods considering temperature and environmental effects, constructed machine learning-based performance prediction models for pultruded profiles. Based on these researches, this work summarizes and collates existing design formulas to compile the China first structural design specification for pultruded profiles, T/CECS 692-2020.

For engineering applications and standards, this work has developed various engineering applications including truss structures (truss bridges and solar panel brackets), frame structures (cooling towers and building domes), cantilever structures (bay windows), and FRP-concrete composite structures (FRP-concrete composite bridges) in China. Through these engineering applications, this work has led the development of many application standards, establishing a comprehensive standard system from products and structural design to engineering applications for pultruded profiles. These standards have laid a solid foundation for the development of pultruded profile structures, expanded the application scenarios, and also provided valuable Chinese experience for the international community.

Pultruded profiles are a type of high-performance material with expansive research prospects and application potential. Based on the research presented in this work, further fundamental research and advanced applications remain to be explored.

Biography

Dr. Peng Feng is a full professor and the head of the Department of Civil Engineering at Tsinghua University. His research interests include high performance fiber-reinforce polymer (FRP) composite structures, concrete material and structures, and advanced construction technologies for extreme environments. He has authored over 180 peer-reviewed journal papers and has achieved a H-index 47 by Google Scholar. He is the inventor of 23 patents on novel structural technologies. He is the project leader of an ISO standard and the chair of four Chinese National Standards, also is the committee member of 15 relevant codes/standards. He led a number of pioneering demonstration projects of FRP structures in China, such as the first all-FRP truss bridge and the largest curve FRP enclosure system. His contributions have been recognized by numerous honors and awards, such as the Fellow of the International Institute for FRP in Construction (IIFC), the National Science and Technology Progress Awards, the XPLORER Prize, the MOE Distinguished Professor, the Young Scientist of NSFC. He severs as the Editor in charge of Special Issues for Engineering Structures, the Associate Editor for Advances in Structural Engineering, and the editorial board member of nine reputative journals.

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RM5504 (Lift 25/26)
Academic Building
HKUST

Enquiry:

Ms. Crystal Lau
cecrystal@ust.hk