CEDD INNOVATION SERIES



Ultra-High Performance Concrete

Foreword

Civil Engineering and Development Department (CEDD) maintains a steadfast commitment to engineering excellence in infrastructure development, continually playing a pivotal role in shaping Hong Kong into a leading city in Asia.

CEDD acknowledges the importance of collaboration with academia and the construction industry in fostering innovation and technological advancement. Through University-Government-Industry (UGI) partnerships, we have been advancing and adopting innovative construction technologies, materials and nature-based solutions in our engineering projects. This integrated approach aims to build a more liveable and climate-resilient city, while achieving co-benefits that enhance productivity and promote environmental sustainability.

The successful adoption of these innovative solutions showcases how cutting-edge innovative engineering technologies and stringent construction protocols from both international and local contexts can be seamlessly integrated to achieve excellence.

I would like to commend the project teams for their tremendous efforts in pioneering novel technologies to effectively overcome Hong Kong's complex site constraints. I also extend my sincere appreciation for the exemplary spirit of collaboration among the project teams, the academia and industrial practitioners, which has been instrumental to the success of these innovative solutions. The adoption of these advancements has not only enhanced construction safety but also improved programme and cost efficiency, resulting in significant time and cost savings.

As always, CEDD is committed to fostering innovation and collaboration for driving the delivery of resilient, safe and sustainable infrastructure in Hong Kong. This CEDD Innovation Series documents these achievements, with a view to inspiring the local construction industry with proven practices and forward-looking solutions.



Mr. FONG Hok-shing, Michael, JP.
Director of the Civil Engineering and Development Department

CEDD

Abstract

In recent years, Ultra-High Performance Concrete (UHPC) has emerged globally as a revolutionary cementitious composite known for its exceptional compressive and tensile strengths, unparalleled toughness, enhanced ductility, and extraordinary durability. Ranging from major infrastructure in Chinese Mainland, Europe, and North America to iconic landmarks in Japan and Malaysia, UHPC has proven its transformative value through diverse field applications and advancements in material science.

In a steadfast commitment to expedite the use of UHPC for Hong Kong's infrastructure development, CEDD set up a Joint Task Force with the Highways Department (HyD) in January 2025 with an aim of propelling UHPC adoption by implementing pilot projects in the Northern Metropolis. Capitalizing on Hong Kong's strategic role as an international hub for infrastructure development, CEDD fosters a collaborative platform for experts across Chinese Mainland, Hong Kong, and the international engineering community to contribute in the alignment of China national standards with local requirements and prevailing global practice. Driven by the valuable experience gained from various ongoing pilot projects, UHPC applications in Hong Kong will become increasingly mature.

Contents

Title Page		1
Foreword		2
Abstract		3
Contents		4
1	Introduction	5
2	UHPC Task Force	5
3	Pilot Projects	7
3.1	Yuen Long South New Development Area	7
3.2	Fanling North / Kwu Tung North New Development Area	8
4	Technical Guidelines for the Structural Use of UHPC in Hong Kong	10
5	Conclusion	11

1. Introduction

Ultra-High Performance Concrete (UHPC) is a revolutionary cement-based composite material that has garnered global recognition as a next-generation sustainable construction solution. Characterized by exceptional compressive strength (typically exceeding 120 MPa), superior durability, low permeability, remarkable toughness and enhanced ductility, UHPC offers transformative advantages over conventional concrete. These include significant reductions in structural member dimensions, minimized maintenance requirements, and extended service life, all of which contribute to lifecycle cost efficiency and carbon emission reduction. In Hong Kong, where infrastructure demands are intensifying amid large-scale developments such as the Northern Metropolis, the need for high-strength, durable, and sustainable materials is particularly surging. With proven successes across the Chinese Mainland, including applications in major bridges, rapid-repair applications, and critical infrastructure, the time is now ripe for Hong Kong to actively promote the adoption of UHPC in public works. This will enhance construction quality, accelerate sustainable development, and reinforce the city's position as a regional leader in innovation.

2. UHPC Task Force

To expedite the widespread adoption of UHPC in Hong Kong's public works infrastructure projects, Civil Engineering and Development Department (CEDD) and Highways Department (HyD) jointly established the UHPC Task Force in January 2025. The Task Force's primary objective is to systematically verify and demonstrate UHPC's superior performance under Hong Kong's unique engineering conditions, addressing industry concerns about construction techniques, cost-effectiveness, and long-term durability. Beyond technical validation, the Task Force serves as a critical bridge between international best practices and local realities, ensuring that UHPC implementation is both technically robust and contextually appropriate. It fosters collaboration among government departments, academia, research institutions, and the private sector to develop locally tailored solutions while aligning with Hong Kong's regulatory, environmental, and construction standards. Through this integrated approach, the Task Force has laid a foundational framework for a technically rigorous, industry-supported pathway toward UHPC wide adoption in Hong Kong .



Photo 1. UHPC Task Force discussing the way forward for UHPC application.

Two pioneering pilot projects are currently driving the practical validation of UHPC in Hong Kong: 1) one in the Yuen Long South New Development Area (YLS NDA) and 2) the other in the Fanling North / Kwu Tung North New Development Area (FLN / KTN NDA). These initiatives are generating the first local data on UHPC performance under Hong Kong's environments, forming the evidentiary basis for future local technical standards.

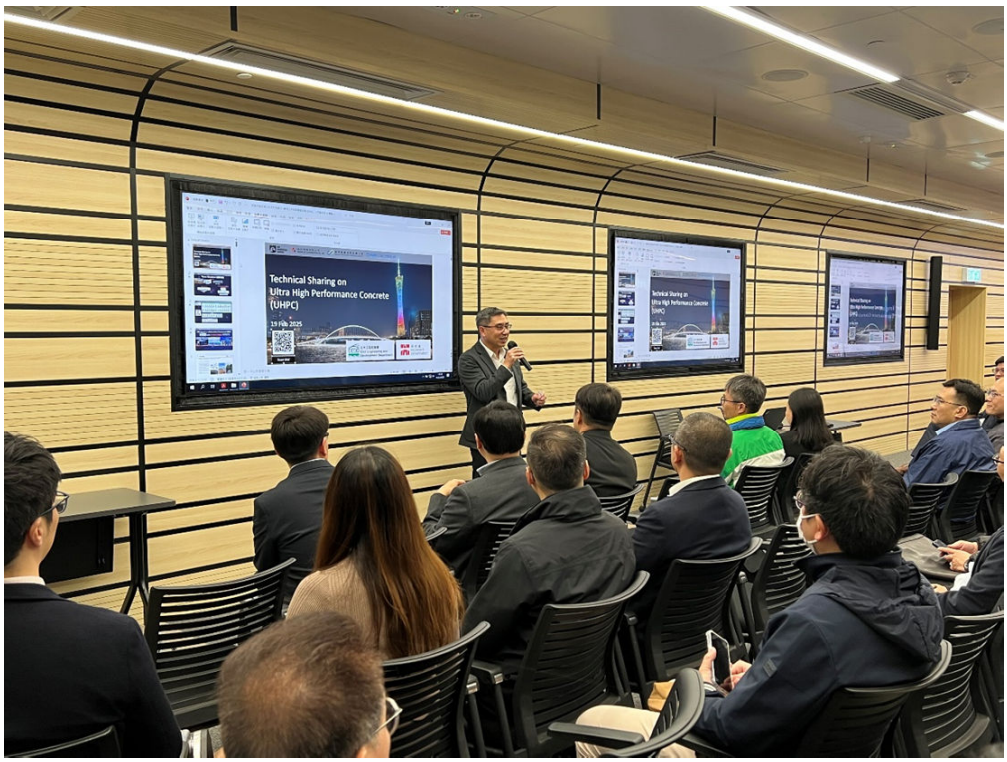


Photo 2. Deputy Director of CEDD, Mr Ma Hon-ngai and Deputy Director of HyD, Mr Ng Chin-hung each delivered a speech at the UHPC sharing session in February 2025.

3. Pilot Projects

3.1 Yuen Long South New Development Area

In the YLS NDA, the project team from the West Development Office (WDO) of CEDD is executing the first public infrastructure project in Hong Kong to deploy UHPC for bridge construction. The original five-span (approximately 90m total length) vehicular bridge design was faced severe constraints due to congested underground utilities. To resolve this, the team reconfigured the structure into a three-span configuration, with each span extended to 32m. While this increased span length avoided utility clashes, it would have significantly compromised clear height beneath the bridge owning to increased beam depth, impeding future maintenance access. The team adopted UHPC as the primary structural material to provide an elegant solution. The material's high strength-to-weight ratio enabled a reduction in beam depth by up to 40% compared to conventional concrete, preserving adequate clearance while maintaining structural integrity. The lighter weight also reduced load demands on substructures, simplifying foundation design and improving constructability within a constrained site. Furthermore, UHPC's exceptional durability promises a substantial reduction in long-term maintenance frequency and lifecycle costs, directly supporting the Government's sustainability goals.

To ensure technical robustness and local compliance, the project team collaborated with Shanghai Municipal Engineering Design Institute (SMEDI) to develop project-specific UHPC technical guidelines. Concurrently, the Hong Kong Building Research Institute (BTRi) established an independent Expert Panel comprising five internationally renowned specialists from Hong Kong, the Chinese Mainland, and overseas, to conduct a rigorous third-party review of the design and construction methodology. The team also conducted site visits to similar completed UHPC bridge projects in the Chinese Mainland, systematically benchmarking design, construction, and quality control practices. The successful completion of these guideline represents a foundational milestone in the localization of UHPC technology in Hong Kong.

The UHPC vehicular bridge project has progressed to the construction stage. Currently, the project team is conducting laboratory and plant trials for the UHPC material. The casting of the UHPC beams is scheduled for Q2 2027, followed by on-site erection in Q4 2027.



Photo 3. The Expert Panel Kick-off Meeting in June 2025. Photo shows the then Assistant Director (Technical) of CEDD, Mr Julian KWAN (second left); the then Chief Engineer of CEDD, Mr Samson LAM (first left); the experts Prof. C S POON (fourth left), Prof. Albert KWAN (fifth left) and Prof. Francis AU (sixth left); the Chief Executive Officer of BTRi, Mr Alfred WONG (seventh left); and other representatives from project team and BTRi.

3.2 Fanling North / Kwu Tung North New Development Area

Parallel to the YLS project, the North Development Office (NDO) of CEDD, in collaboration with HyD, initiated a comprehensive series of on-site UHPC trials in FLN / KTN NDA in August 2025. The trials are designed to evaluate UHPC's performance across the full spectrum of application processes, including raw material sourcing, transportation, mixing, placement, curing, and formwork removal, under Hong Kong's challenging environmental and urban conditions. A key focus is comparing UHPC's field behavior against that of conventional concrete, particularly in terms of workability, setting time, and early-age strength development. Innovatively, the team is also testing early-strength UHPC formulations tailored for urgent road repair works and short-duration road closures, which are critical needs in Hong Kong's densely populated urban environment. Different thicknesses and gradients of pavement sections have been cast to assess performance across varied applications, including footpaths, vehicle lanes, and emergency repair zones.



Photo 4 Piloting Use of Ultra High Performance Concrete under FLN / KTN NDA Project

On 5 September 2025, the NDO held the "UHPC Pilot Project Launching Ceremony" at the Fanling North test site. The event was officiated by Mr Michael FONG, Director of the CEDD and Mr Tony YAU, Director of the HyD, alongside industry stakeholders and technical teams. It featured live demonstrations of UHPC mixing and pouring, interactive site tours, and technical briefings on preliminary findings. Participants observed firsthand the material's fluidity, rapid setting characteristics, and high-density finish. The trial outcomes have already informed refinements in local mix designs, construction protocols, and quality assurance procedures, providing critical data to support the development of broader technical guidelines.



Photo 5. Ultra High Performance Concrete Pilot Project Launching Ceremony. Photo shows the Director of CEDD, Mr. Michael FONG (front row, fourth left); the Director of HyD, Mr. Tony YAU (front row, fourth right); the Chief Executive of the Hong Kong Construction Materials Association, Mr. Ambrose NING (front row, second left); members of UHPC Task Force; representatives from consultants and other representatives from the two departments



Photo 6. Demonstration of the site trial

4. Technical Guidelines for the Structural Use of UHPC in Hong Kong

Building on the insights from both pilot projects, the WDO, in collaboration with the BTRi, has developed the first locally adapted Technical Guidelines for the Structural Use of UHPC in Hong Kong, which was promulgated in the Joint SCCT-HKCI International Conference on Concrete Technologies on 12 December 2025. This document represents a significant advancement in the local engineering sector, grounded in practical field experience and informed by international best practices. The development process was guided by leading academic experts from The Hong Kong Polytechnic University, Professor C.S. Poon and Professor Y. Huang, who provided authoritative direction on material properties, durability mechanisms, and microstructural behaviour under Hong Kong's unique environmental and loading conditions. Mannings (Asia) Consultants Ltd. contributed critical field-based recommendations, integrating industry experience in batching, placement, curing, and quality control. This ensures the guidelines are not only technically rigorous but also implementable by contractors and consultants in real projects.

To ensure alignment with international and Chinese Mainland standards, the draft guidelines underwent rigorous review by internationally renowned experts. These included Academician J. P. Liu, a leading authority in concrete materials and member of the Chinese Academy of Engineering from Southeast University, China, and Professor Sudharshan N. Raman from Monash University Malaysia. Their expertise in high-performance cementitious systems ensured the guidelines reflect the most current global and regional standards.

Furthermore, WDO conducted extensive consultations with key industry stakeholders, including the Hong Kong Institution of Engineers (HKIE), the Association of Consulting Engineers of Hong Kong (ACEHK), the Hong Kong Concrete Institute (HKCI), the Hong Kong Construction Materials Association (HKCMA), and the Hong Kong Construction Association (HKCA). Their feedback was instrumental in refining the guidelines to meet the practical, regulatory, and safety expectations of Hong Kong's construction community. The final version received widespread endorsement from both government departments and industry professionals, marking a pivotal step toward institutionalizing UHPC adoption.



Photo 7. The Launch Ceremony of the Technical Guidelines for the Structural Use of UHPC in Hong Kong. Photo shows the honorable guests of the ceremony (from left to right), Mr Benjamin CHAN, Project Manager of WDO, CEDD; Prof. C S POON, Head of Department of Civil and Environmental Engineering of The Hong Kong Polytechnic University; Mr C K HON, Chairperson of BTRi; Mr Michael FONG, Director of CEDD; Mr J P LIU, Member of the Chinese Academy of Engineering; Dr. Raymond CHEUNG, Head of GEO, CEDD; and Mr Gavin WONG, Deputy Project Manager of NDO, CEDD.

5. Conclusion

The adoption of UHPC in Hong Kong represents a transformative leap toward smarter and more sustainable infrastructure. Through the coordinated efforts of the UHPC Task Force, pioneering pilot projects in the YLS and FLN / KTN NDAs, the development of the first local technical guidelines, and the roadmap toward a formal Hong Kong Standard, the territory is positioning itself as a regional leader in advanced material innovation. By harnessing its strengths as a “super connector” and “super value-adder” within the Greater Bay Area, Hong Kong can not only import cutting-edge technology but also refine and export its own standards for UHPC application worldwide, setting a new benchmark for urban resilience and sustainability in the 21st century.

CEDD INNOVATION SERIES

