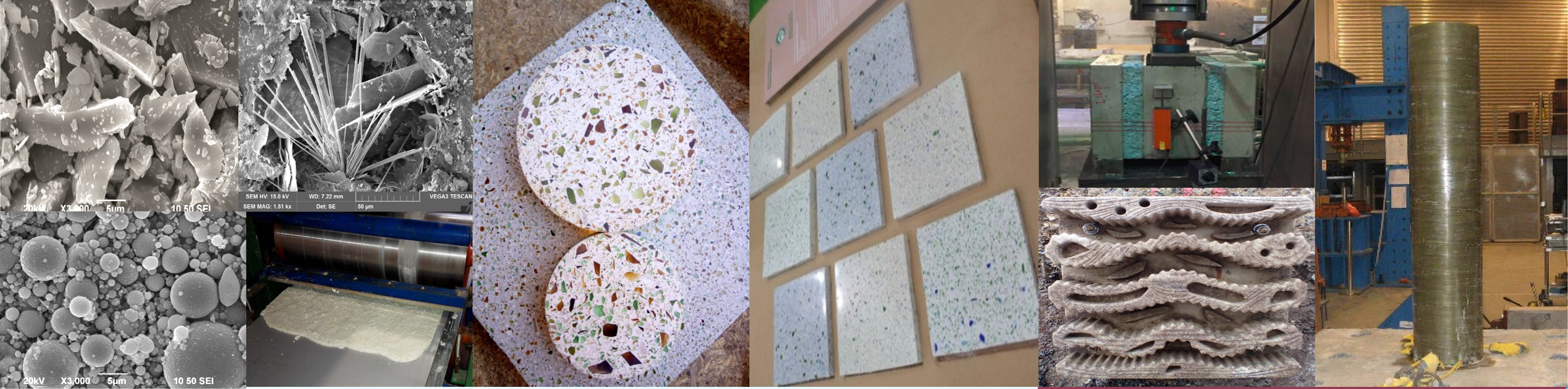

Concrete Technology Laboratory

Room (QT 005), Block (QT),

Department of Civil and Environmental Engineering,

The Hong Kong Polytechnic University

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

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

Opening Minds • Shaping the Future
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Introduction

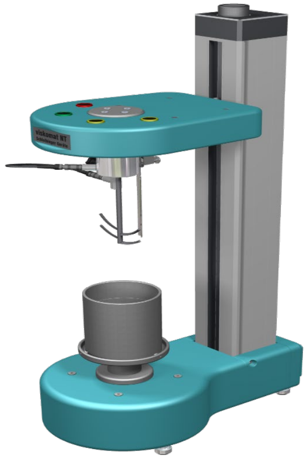
The Concrete Technology Laboratory is fully equipped with world-class facilities for testing on building materials, e.g., concrete, steel, masonry, FRP, steel-concrete composites etc. The laboratory serves a broad spectrum of activities covering those related to teaching, research, development, and consultancy; such as:

- Physical tests of raw materials, viz., sieving, density, water absorption, crushing value, 10% fine value, etc.
- Preparation of fresh cement and concrete mixture, such as fresh mortar, concrete, grout, concrete blocks, geo-polymer, etc.
- Standard experimental tests for building materials, e.g., compression, tensile, flexural and splitting tests, ultrasonic measurement, static and dynamic Young's-modulus tests, etc.
- Large-scale performance test for structural members which includes compression, tension, dynamic failure test, etc.
- Durability tests of building materials, in particular shrinkage, chloride permeability, fire resistance, carbonation, etc.
- Advanced and additional tests, namely abrasion resistance, rheology and workability of binders, experiments on fiber reinforced concrete, accelerated carbonation under pressure and flowing conditions, etc.

Main Equipment

Crocker Rotating Pan Mixer

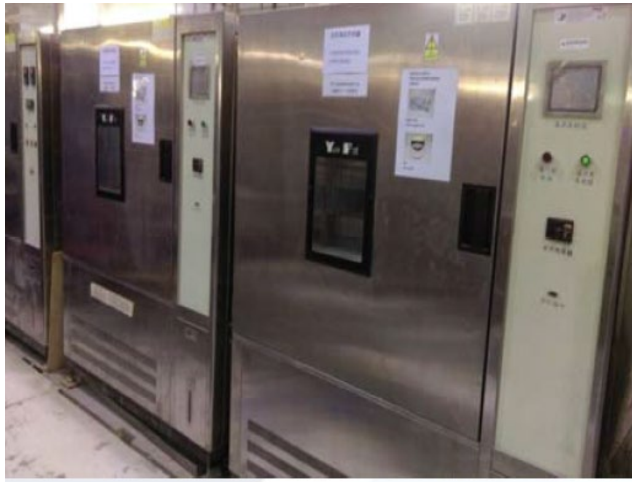
The Croker Rotating Pan Mixer is a concrete mixer. It incorporates twin drives with separate geared motor units powering the rotating pan. Together with the twin spring mounted mixing pedals and fixed scraper blades at sides, it enables to produce high quality and consistent concrete mix.



Viskomat NT - Rheometer for Mortar and Paste

The viskomat NT is a versatile rotational rheometer for determining the rheological behavior of fine-grained building materials such as cement paste, mortar, fine concrete, plaster etc. The equipment is generally employed to assess:

- flow curves and rheological parameters
- stiffening behaviour as a function of time a stirring speed
- effects of concrete admixtures and mineral blending agents.



Environmental Chambers

The temperature and humidity in insulated environmental chambers are monitored constantly and automatically controlled to provide the ideal control conditions for curing building materials, in particular concrete, cement mortar, cement paste, etc.

Main Equipment

Matest Test Frames Group

This testing equipment, Matest Two Frames Group, is used to measure the mechanical properties of building materials.

It offers the considerable advantage to perform compression tests on concrete cube, cylinder and block specimens; flexural tests on concrete beams, and by using other suitable accessories, to perform splitting tensile test.

MTS 815 Test System

The MTS Model 815 test system is ideal for uniaxial tests that are critical to research works, to deliver high uptime and dependable results.

It offers high axial force capacity, with compression ratings above 4000kN, particularly suitable for carefully controlled studies of material-failure behaviour.

High-Temperature Furnace with MTS 815 Compression Test System

A tailor-made High-Temperature Heating Furnace with MTS 815 Test System is designed and allows to conduct compression test under a constantly heating environment up to a temperature of 800 degree Celsius. Such unique device is used to conduct research on fire resistance of building materials.

Main Equipment

High-Temperature CO_2 Autoclave

A customized High-Temperature CO_2 Autoclave (produced by Haage Anagramm Technologien GmbH) is employed to conduct the CO_2 curing of building materials under an elevated temperature.

The equipment provides a precise and reliable testing environment for advanced studies on the carbonation behavior of construction materials at a high pressure and a high temperature.

Chloride Ion Penetration Device

The testing system is generally employed to determine the total charge passed and electrical conductivity of concrete. Furthermore, it can provide a rapid indication of concrete specimen resistance to the penetration of chloride ions.

Research Team

Ir Prof. Poon, Chi Sun (潘智生)

Michael Anson Professor in Civil Engineering, Chair Professor of Sustainable Construction Materials, Head of Department of Civil and Environmental Engineering, Director of Research Centre for Resources Engineering towards Carbon Neutrality

Email: cecspoon@polyu.edu.hk

Homepage: https://www.cecspoon.com

Prof. Teng, Jin-Guang (滕錦光)

President

Ko Jan Ming Professor in Sustainable Structures and Materials, Chair Professor of Structural Engineering

Email: jg.teng@polyu.edu.hk

Homepage: https://www.polyu.edu.hk/cee/files/people/academic_staffbk/9.pdf

Prof. Dai, Jian-guo (戴建國)

Professor

Email: cejgdai@polyu.edu.hk

Homepage: http://www.ceejgdai.com

Prof. Yu, Tao (余濤)

ADoRCDSE & Professor

Email: tao-cee.yu@polyu.edu.hk

Homepage: https://www.polyu.edu.hk/cee/staff/academic-staff/yu-t/

Academic Staff

Prof. Tsang, Chiu-Wa, Daniel (曾超華)

Professor

Email: dan.tsang@polyu.edu.hk

Homepage: https://www.dan-tsang.com/

Dr Chan, Tak Ming (陳德明)

Associate Professor

Email: tak-ming.chan@polyu.edu.hk

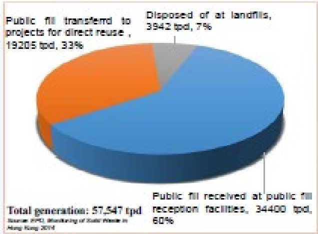
Homepage: https://www.polyu.edu.hk/cee/staff/academic-staff/chan-t-m/

Research Spotlight

CO_2 Curing Techniques for Production of Eco-concrete Block

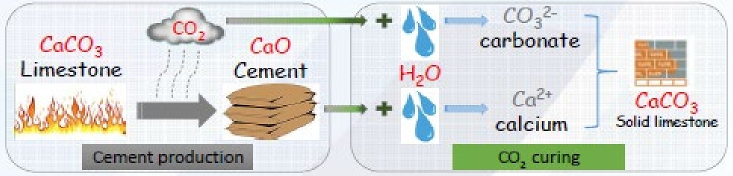
Background:

Hong Kong's landfills are under significant pressure and estimates suggest that based upon current waste generation rates, they will be filled up in the near future. Construction & demolition wastes are a key consideration as they account for up to 40% of wastes sent to landfills.



Fundamental:

Recycling waste carbon dioxide to react with cement and construction & demolition wastes, to make greener concrete blocks.



Industrial Technology Roadmapping and Environmental Benefits:

- Turning construction wastes to construction products which may contain up to 97% wastes;
- Accelerated strength development (12 hours CO_2 curing ≈ 28 days air curing);
- Reduced 50% shrinkage;
- CO_2 uptake of block is 5.2% by weight.

Enquiry:

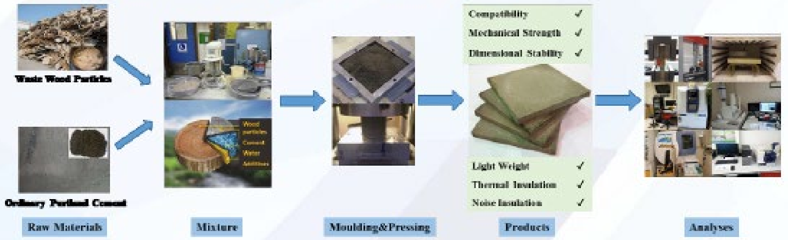
Prof. **Poon Chi Sun** (cecspoon@polyu.edu.hk), Room ZS948, TEL: 2766 6024

Concrete Technology Laboratory

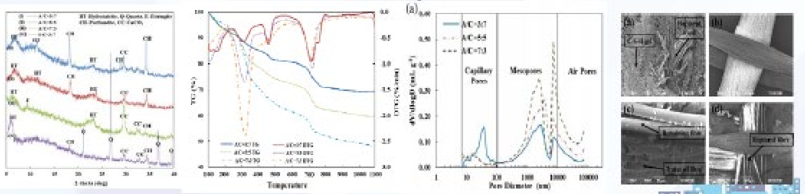
Recycling Timber Waste into Cement-bonded Wood Particleboards

Motivation

Tailoring Cement-bonded Particleboard



Chemical & Microstructure Analysis



Contact Information:
Dr. Daniel C.W. Tsang (dan.tsang@polyu.edu.hk)
Department of Civil and Environmental Engineering, Hong Kong Polytechnic University, Hung Hom, Hong Kong, China.

Research Spotlight

Axial Compression Tests of HSS Spiral Confined Concrete-Filled Steel Tubular (CCFST) Columns

Prof J.G. Teng's research group

Background

Concrete-filled steel tubular (CFST) columns have been extensively studied and widely used in practice. Existing research has shown that rectangular CFST columns are much less ductile than their circular counterparts, particularly when high-strength concrete (HSC) and thin/high-strength steel (HSS) tubes are used, which is a major concern in structures designed to resist seismic loading. This project is aimed to develop a new form of high-performance rectangular CFST columns through the use of HSS spirals with a yield stress greater than 1,000 MPa to provide strong confinement to the infilled concrete and improve the ductility (Figure 1).

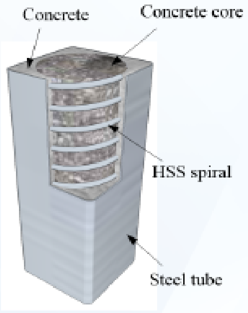


Figure 1 New composite (CCFST) columns

Preliminary Test Results

Axial compression tests carried out in the laboratory of the Hong Kong Polytechnic University (Figure 2) have shown that the rectangular CCFST columns exhibits excellent performance in both load-carrying capacity and ductility, with the inner HSS spirals effectively confining the concrete due to the large elastic range and high strength of HSS. The comparison of axial load-axial strain curves for the CFST column and the CCFST columns with different spiral volume ratios is shown in Figure 3.

Figure 2 Failure state

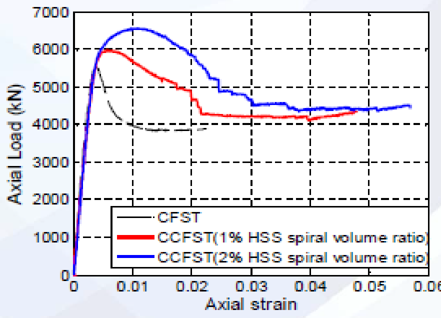


Figure 3 Comparison of axial load-strain curves between CCFST and CFST columns

Development of Precast BFRP Grid-reinforced Geopolymer Sandwich Wall Panels for Green Building Construction

Principal Investigator: Dr. Jian-Guo DAI

Precast concrete sandwich panel is widely used around the world. The sandwich panel mainly consisted inner and outer layers, core insulation and shear connectors. The inner and outer concrete layer is typically the steel reinforced concrete layers. The core concrete layer can be EPS or XPS insulation foam. The shear connector can be steel truss shear connector or FRP shear connector. This project aims to develop a new kind of precast concrete sandwich panel system. Three innovations are listed as shown in follows:

1. Geopolymer concrete is used to replace the traditional OPC concrete for fabrication the inner and outer concrete layer to achieve environmental friendliness.
2. BFRP rebar or grid is used to replace the steel rebar to achieve higher durability
3. Propose a new kind of GFRP shear connector

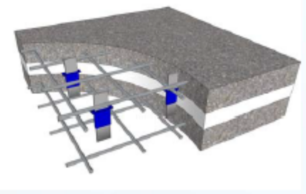


Fig.1 Typical sandwich panel

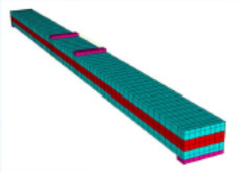


Fig.2 Numerical model of sandwich panel

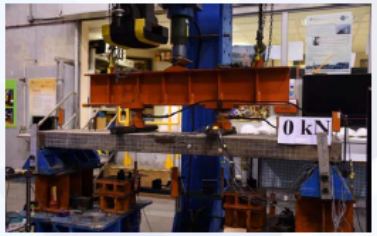


Fig.3 Flexural test on reinforced geopolymer concrete slab

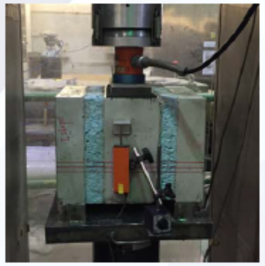


Fig.4 Direct shear test on GFRP shear connector

Lab-in-charge and Deputy Lab-in-Charge

Lab-in-Charge

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Email: cecspoon@polyu.edu.hk

Homepage: https://www.cecspoon.com

Deputy Lab-in-Charge

Dr Chan, Tak Ming (陳德明)

Associate Professor

Email: tak-ming.chan@polyu.edu.hk

Homepage: https://www.polyu.edu.hk/cee/staff/academic-staff/chan-t-m/

Technical Staff

Technical Staff

Mr. Lai Yu Man, Harry

Email: ymharry.lai@polyu.edu.hk

Tel: (852) 2766 6035

Address
Room (QT005),The Hong Kong Polytechnic University

Opening Hours
Monday 8:45am – 12:30pm, 1:30pm – 5:45pm
Tuesday to Friday 8:45am – 12:30pm, 1:30pm – 5:30pm
(excluding Saturday, Sunday & public holidays)

Technical Staff

Mr. Yip Kim Fung, Francis

Email: kimfung.yip@polyu.edu.hk

Tel: (852) 2766 6021

Technical Staff

Mr. Tse Chun Tai, Samualson

Email: chun-tai.tse@polyu.edu.hk

Tel: (852) 2766 6019