

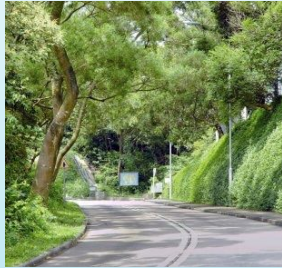
Revolution of the Public Works Laboratories 工務試驗所的革新

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土力工程處副處長(規劃及測試)

Geotechnical Engineering Office 土力工程處
Civil Engineering and Development Department
土木工程拓展署

Geotechnical Engineering Office

our services are expanding



Man-made
Slope
Upgrading
& Landscape
Treatment



Control of
Geotechnical
Works



Natural Terrain
Landslide Risk
Management



Landslide Emergency
Services



Ground Investigation
Geological Survey



Development of
Geotechnical
Standards &
Guidelines



Public Education &
Communication



Material Testing



Prefabricated Steel Yard



Reclamation



Explosive Control
Quarry (Surface & Underground)



Cavern Development

Materials and Testing Division

Construction Materials Testing

Undertake construction materials compliance testing according to international and local standards

Setting Standards

Develop and promulgate construction materials testing standards in collaboration with industry stakeholders

PWL

Forensic Testing

Provide testing services to forensic investigations conducted by Government Departments

Research and Development

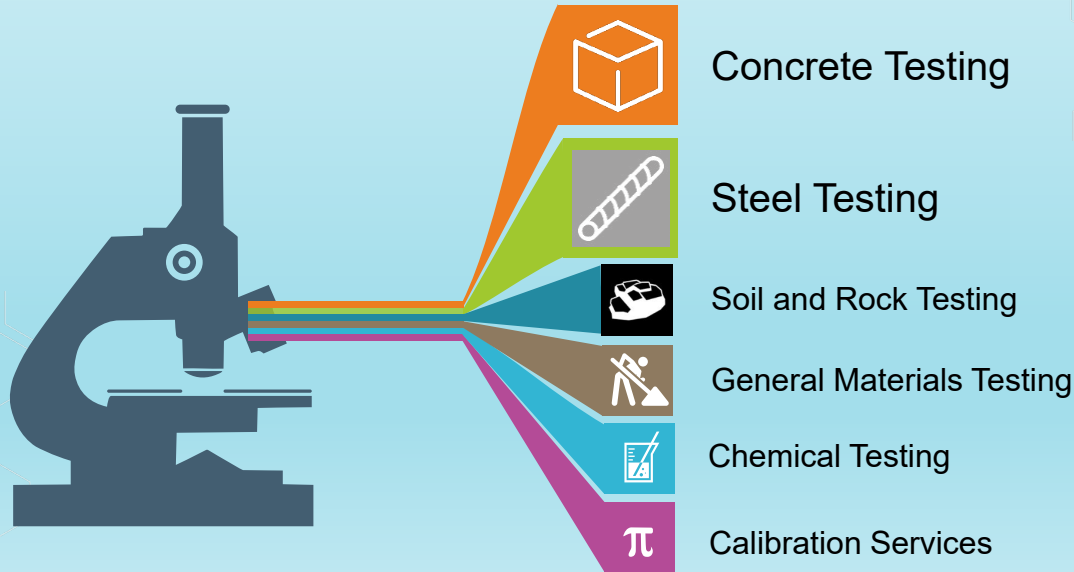
Explore and research into new construction materials and develop new testing techniques to meet the needs of construction industry





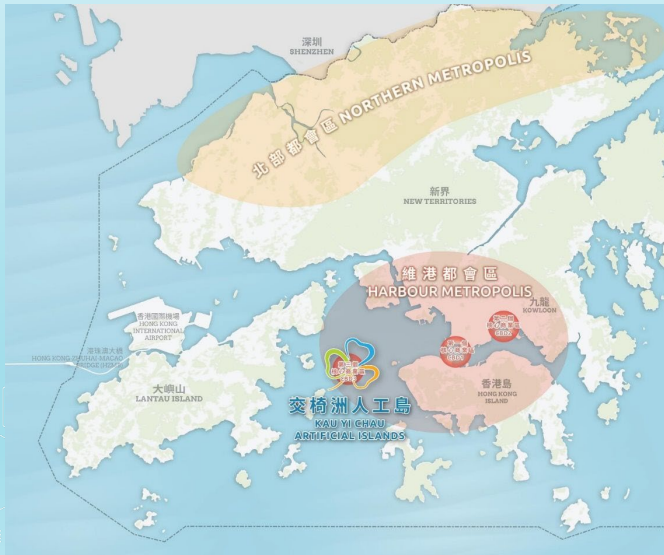
Construction Materials Testing

- 🔑 Public Works Laboratories provides an extensive range of material testing services
- 🔑 More than **600,000** tests for Government projects annually
- 🔑 More than **200,000** concrete cube tests for Government projects annually
- 🔑 More than **30,000** steel rebar tensile tests for Government projects annually
- 🔑 More than **390** laboratory tests in our test directory



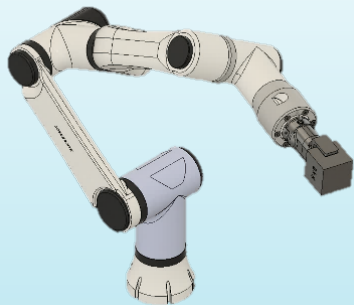
Pain Points

- 🔧 **Increasing testing demand** to cope with upcoming expeditious infrastructure and housing developments
- 🔧 **Manpower shortage** is becoming more serious
- 🔧 Conventional test procedures are **tedious, repetitive and labour-intensive**
- 🔧 Reliability of test results may be affected by **workmanship and human errors**
- 🔧 Need to improve the **occupational safety and health** of laboratory staff

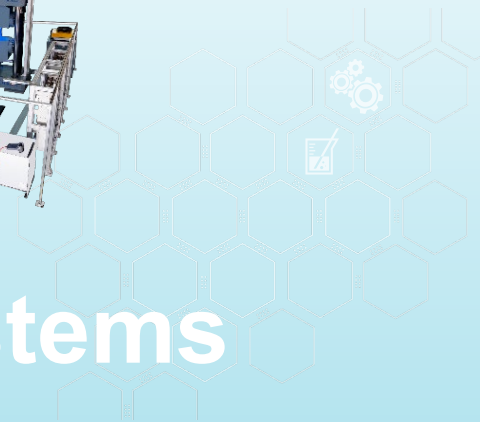
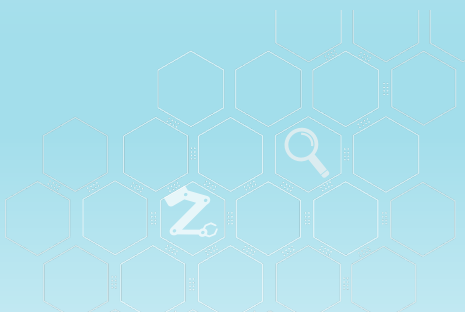
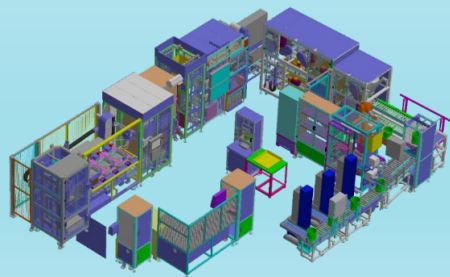


Human Error





Automated Testing Systems



Market Research

- ❏ **No Automation Experience** in local construction materials testing industry
- ❏ In Dec 2017, we visited overseas laboratories with Automation Experience
 - ❏ Laboratory with **Automated Steel Rebar Testing System** in Germany
 - ❏ For steel rebar testing, the automation technology is mature
 - ❏ Laboratory with **Semi-Automated Concrete Cube Testing System** in Switzerland
 - ❏ For concrete cube testing, not a fully automated testing system (i.e. from curing to testing)

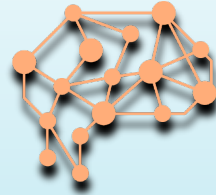


Pioneer Automation Systems

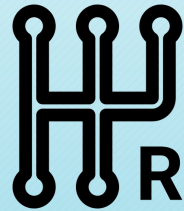
- ✂ **Concrete Cube Testing and Steel Rebar Testing** were selected as the pilot projects
 - ✂ Huge Test Demand (totally ~300,000 tests p.a.)
 - ✂ Critical to Structural Safety and Serviceability
- ✂ **Fill Compaction Related Testing (e.g. Proctor Compaction Test)** were also selected
 - ✂ Upcoming Expeditious Infrastructure Projects (Reclamation, Site Formation, Earth Filling)
 - ✂ Critical to Slope, Foundation and Reclamation Stability and Quality



Adoption of Innovation and Technology



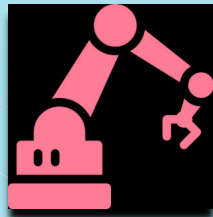
Artificial Intelligence (AI)



From Manual to
Automation



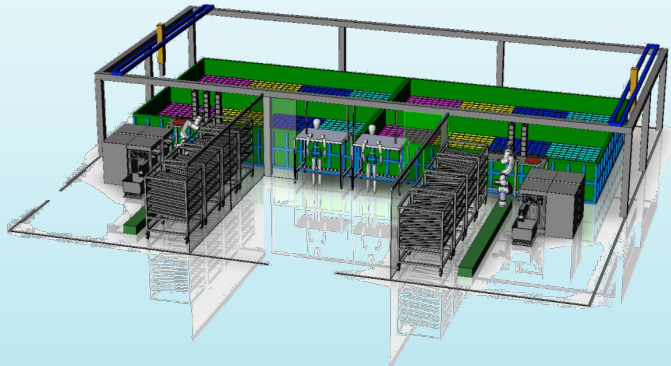
Internet-of-Things
(IoT)



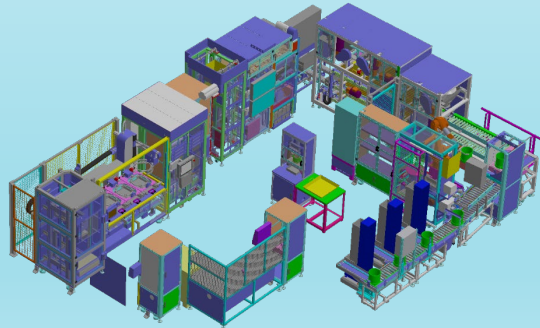
Robotics



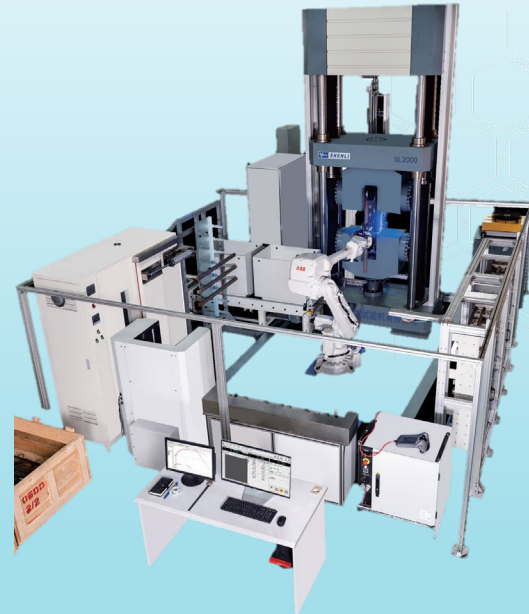
Automated Testing Systems



**Automated Concrete
Cube Testing System**



**Automated Proctor
Compaction Test System**



**Automated Steel Reinforcing
Bar Testing System**



Automated Testing Systems Development Process

GEO initiated the feasibility study on the adoption of automation technology in construction materials testing

2017

Funded by TechConnect Block Vote from the then Innovation and Technology Bureau (ITB), started developing the **Automated Concrete Cube Testing System**

2018

Collaborated with Logistics and Supply Chain MultiTech R&D Centre (LSCM) to develop the **Automated Concrete Cube Testing System**

2019

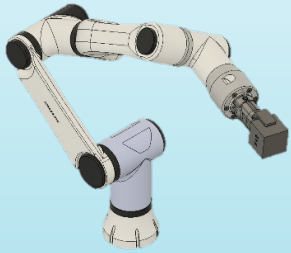
Funded by TechConnect Block Vote from the then Innovation and Technology Bureau (ITB), started developing the **Automated Proctor Compaction Test System**

2020

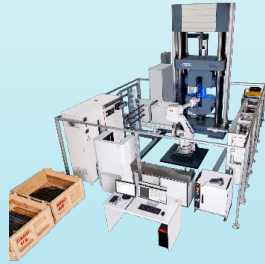
Collaborated with other I&T organisations to develop the **Automated Proctor Compaction Test System** and introduced the **Automated Steel Rebar Testing System**

Automated Testing Systems Development Process

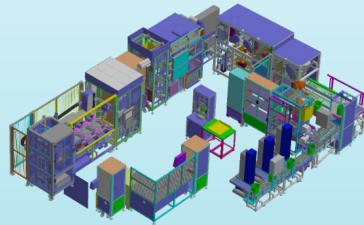
Automated Concrete
Cube Testing System



Automated Steel
Rebar Testing System



Automated Proctor
Compaction Test System



New Automated
Testing Systems are
being explored

Smart PWL

Roll out of Automated Concrete Cube
Testing System and Automated Steel
Rebar Testing System

2022

Completed the development of
Automated Proctor Compaction
Test System

2023

Conventional Concrete Cube Test Procedures



Dimension measurement by caliper



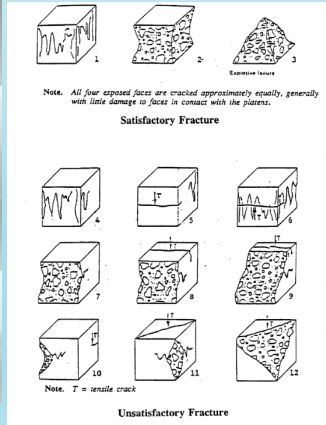
Mass measurement



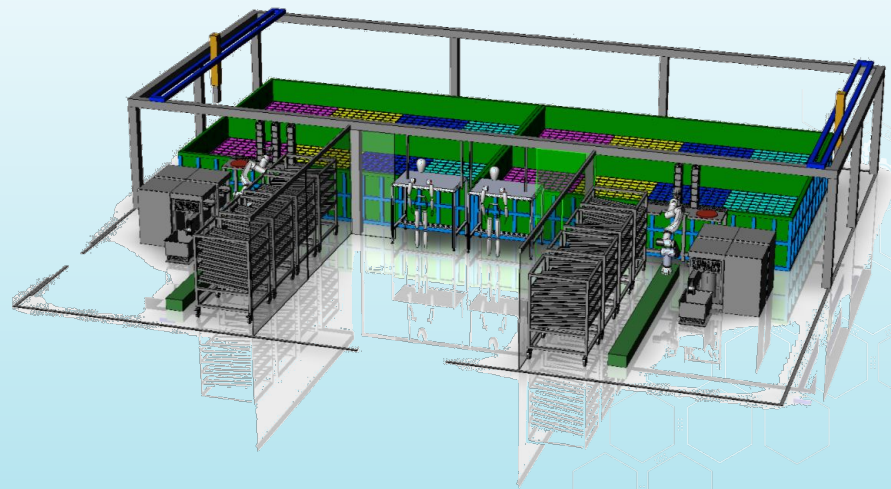
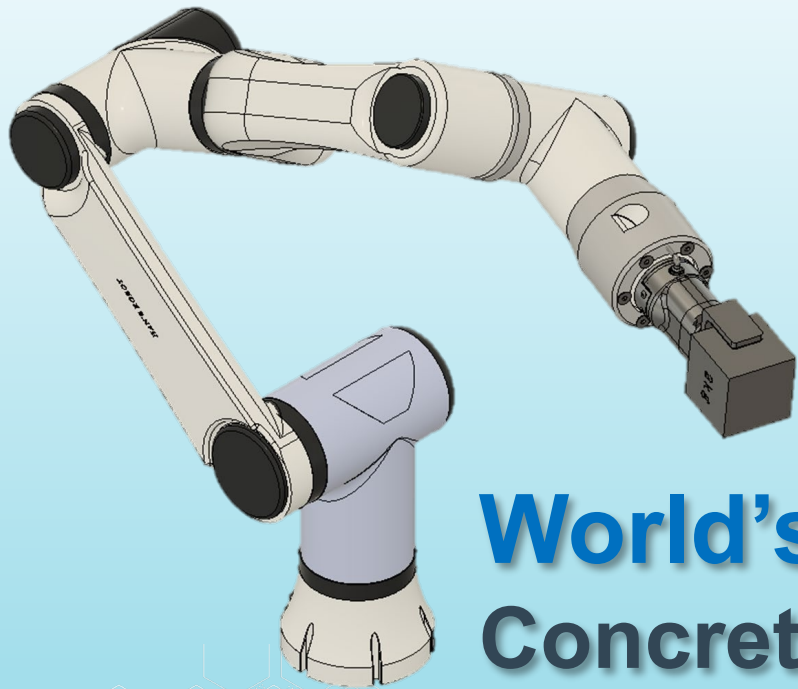
Manually placing test samples into curing tank



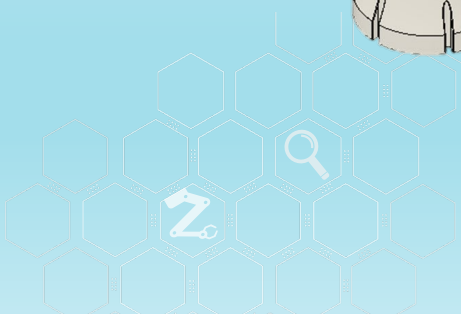
Identification of fracture pattern



Carrying out compression test within the required testing time frame

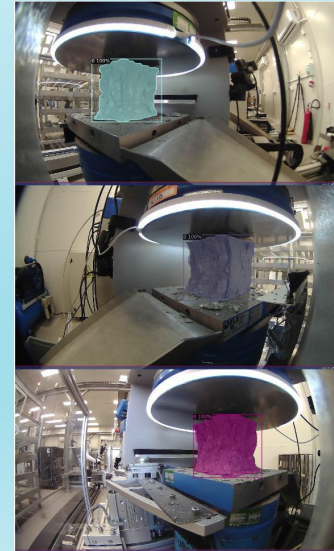


World's First Fully Automated Concrete Cube Testing System From Concrete Curing to Compression Testing



Technological Advancement

- ✂ The World's First System automating the entire concrete cube testing process
- ✂ Radio Frequency Identification, Custom-made Telescopic Hoist, 6-axis Robotic Arm with movement accurate to 0.05mm
- ✂ Newly developed Computer Vision Algorithm to identify the fracture mode of a tested concrete cube by the Artificial Intelligence System





Conventional Steel Rebar Test Procedures



Length measurement



Mass measurement



Inscribing equidistant marks on test specimen



Setting up Universal Testing Machine



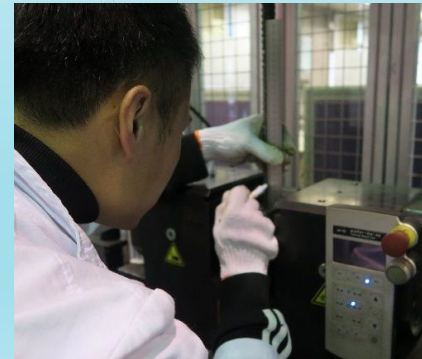
Measurement of the final gauge length



Tensile test (removing extensometer upon yielding)

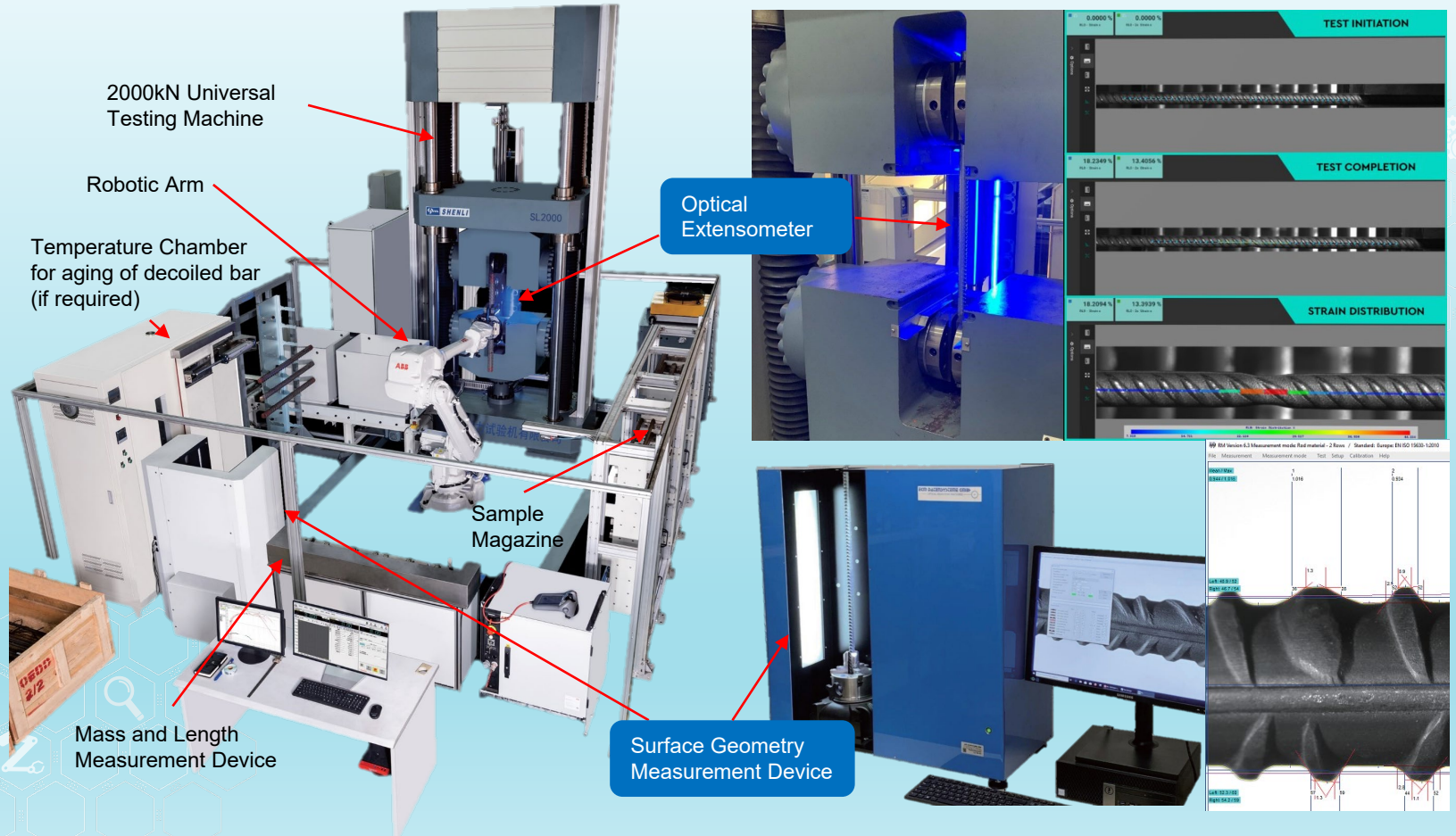


Fixing extensometer to the test specimen



Gripping test specimen in the machine

Automated Steel Rebar Testing System



Conventional Proctor Test Procedures

Sieving



Subdividing



Mixing



Compaction



Test Sieve



Riffle Box



Adding water and mixing



4.5kg Rammer

CBR Mould



Automated Testing System for Proctor Test

Safety Laser Curtain



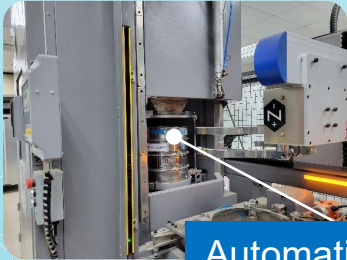
Automatic Water Sprayer



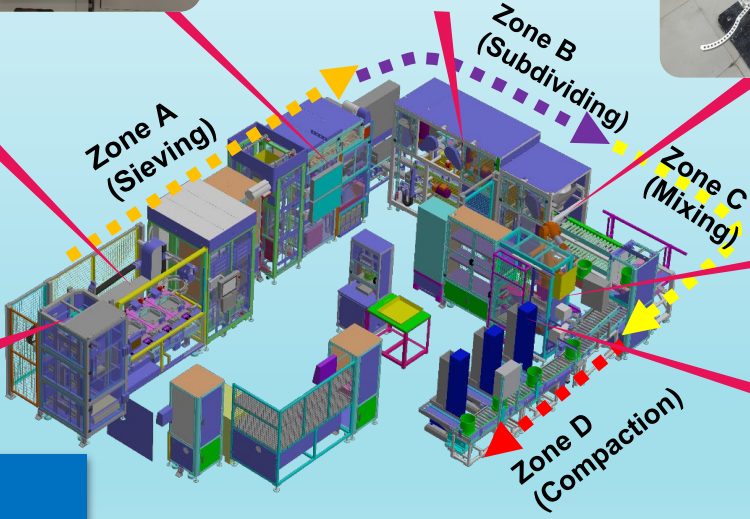
Automatic Mixer



Automatic Soil Compactor



Automatic Sieve Shaker





Affirmed by the **Hong Kong Accreditation Service (HKAS)** that the issuance of electronic test reports conforms to its accreditation requirements.



LEGALLY ENFORCEABLE

- The digital signatures on the reports are authorised and issued by a certification authority recognised under the Electronics Transaction Ordinance (ETO) (Cap. 553).
- Digitally signed test reports are protected. Any modification to the test reports would render the digital signatures invalid.



ENHANCED SITE MANAGEMENT EFFICIENCY

- Data required can be extracted autonomously by computer systems. Manual data input is no longer needed, which avoids any human errors.
- The implementation of electronic test reports reduces manual filing process and storage spaces required. The risk of test reports being tampered with or accidentally lost can also be minimised.



PAPERLESS CULTURE

- Approximately 2 million sheets of A4-size paper (equivalent to 200 trees) can be saved per annum, contributing to the preservation of precious forest resources.



LIMS E-Portal

I. Test-related Information Hub

II. Revamped LIMS for Handling Test Requests
(for registered user only)

III. E-reports Validation Engine



PUBLIC WORKS LABORATORIES

To ensure reliable, efficient and effective construction testing

Information Hub

Laboratory Information Management System Portal

Validation of Electronic Test Reports

Registration Form for Testing of Construction Materials

Public Works Laboratories Test Directory

Procedures / Guideline for Testing Service

Test Related Document

Test Request Form

Login

User ID:

Enter user ID

Password:

Enter password



Login

[Forgot password](#)

[Registration](#)

Or

Login with iAM Smart

[More info for iAM Smart](#)

Validation Page



Publicity

- Wide media coverage
- Overwhelming responses from industry practitioners and academia
- Strong interest from the public instilled



Media Briefing



Opening Ceremony & Visit by industrial practitioners



Open Day & InnoCarnival

Awards

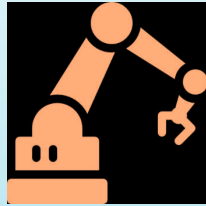
- 🔑 HKIE Grand Award 2023 (Industrial Category) - Certificate of Merit
- 🔑 48th International Exhibition of Inventions Geneva 2023 - Bronze Medal
- 🔑 3rd Asia Exhibition of Innovations and Inventions Hong Kong - Gold Medal



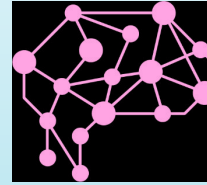


Positive Impact on the Material Testing Industry

- Successful application of innovative and advanced technologies
- Showcase and stimulates the modernisation of construction materials testing industry



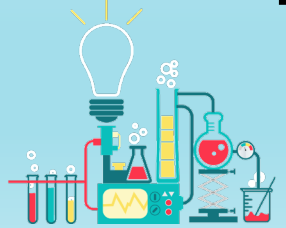
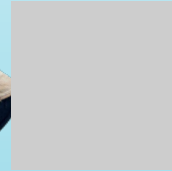
Robotics



Artificial Intelligence

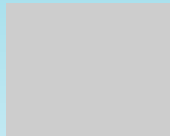


Exciting
Advanced
Dirty
Sustainable
 Dangerous



Laboratory Testing Knowledge

Intelligent



Cloud Computing



Smart Laboratory of Tomorrow

- 🔑 The PWCL will be reprovisioned in caverns at Anderson Road Quarry Site by 2027.
- 🔑 A Digital Twin platform will be implemented, consisting of an Asset Management System integrated with BIM with IoT devices and a customised dashboard for monitoring, managing and maintaining various built assets in the cavern laboratory.

