



THE UNIVERSITY OF  
MELBOURNE

Melbourne School  
of Engineering

# GEOTECHNICAL LABORATORY AND IN SITU TESTING



Providing specialised geotechnical testing and characterisation with state-of-the-art testing equipment for research and infrastructure projects.

The University of Melbourne's Geotechnical Engineering Laboratory has had significant investment over the past 10 years on equipment and staff to support our research activities. Capabilities include soil and rock characterisation for complex infrastructure, and decommissioning and rehabilitation projects.

## Laboratory Tests

- » Triaxial tests (including stress paths and cyclic)
- » Simple and direct shear tests
- » Consolidation tests
- » Swell tests (constant load and constant volume)
- » Rowe cell test
- » Universal testing machine (UTM) including static and cyclic testing of soil, aggregate and rock
- » Dielectric permittivity and P & S wave velocities

## In situ Tests

- » Geophysics (GPR, EM, Seismic, LWD)
- » Thermal conductivity (laboratory and in situ TRT)
- » Field plate load tests
- » Field monitoring using optic fibres (strain, temperature)
- » Field moisture content (including remote logging)
- » GEMS (Geothermal Energy Mobile System up to 120 kW)
- » Underground services and utilities locator
- » Pavement modulus

### UNIVERSAL TESTING MACHINE

The load frame houses a high speed, precision micro stepper motor that moves the load platen and thereby applies a vertical load to the soil specimen. It reduces time required for testing.

#### CAPABILITIES:

- » Unconfined compression (UC)
- » Incremental consolidation and swell
- » Indirect Tensile Strength (IDT)
- » Sample size of 38, 63, 76 and 100mm diameter



### PILE FIELD TEST SYSTEM

To confirm the design load calculations and provide guidelines for setting up the limits of acceptance for routine tests.



### PLATE LOAD TESTING

A Plate Load Test is a field test for determining the ultimate bearing capacity of soils and the likely settlement under a given load. The Plate Load Test basically consists of loading a steel plate placed at the foundation level and recording the settlements corresponding to each load increment.



### TRIAxIAL TESTING SYSTEMS

Triaxial testing is used to measure the properties of soils, weathered rocks, rock samples and other cemented materials. Typically, triaxial testing can be used to determine the shear strength and stiffness of materials.

#### CAPABILITIES:

- » Pressure range 1 to 100 MPa
- » Sample size 38mm to 100mm
- » Triaxial compression and extension
- » Isotropic, anisotropic, K0, and any stress path tests (load control)
- » Cyclic triaxial testing
- » Constant head permeability
- » Constant rate of flow permeability
- » Local strain measurement using particle image velocimetry
- » Shear modulus



### SIMPLE AND DIRECT SHEAR SYSTEM

Capable of direct shear type and simple shear type testing of interfaces between soil and structural materials.

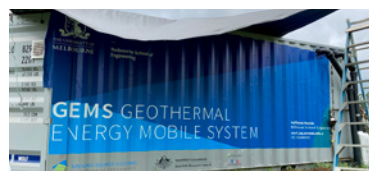
#### CAPABILITIES:

- » Cyclic simple shear
- » Direct shear tests
- » Simple shear tests



### GEO THERMAL ENERGY MOBILE SYSTEM (GEMS)

A mobile geothermal plant capable of delivering 30 to 120 kW of heating and cooling using the ground.



### LAB THERMAL PROPERTIES

Laboratory (and in situ) thermal properties of soils, rocks and other solid and liquid materials.

#### CAPABILITIES:

- » 0.1 to 8 W/mK
- » Min size: 1 cm<sup>2</sup> (Rocks) to ~5 cm<sup>2</sup> x 10 cm (soils)
- » Laboratory testing
- » Capable of field testing



### THERMAL RESPONSE TEST (TRT)

In situ thermal properties of the ground in both cooling and heating, performed on pilot borehole ground heat exchangers and energy geo-structures (energy piles, energy water etc).

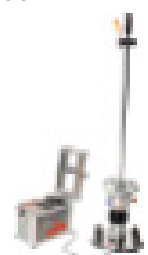
#### CAPABILITIES:

- » 2.5, 5, 7 and 11 kW
- » Three units available (custom made and No. 2 GeoCube™)



### LIGHT WEIGHT DEFLECTOMETER (LWD)

The Zorn ZFG Lab 3.0 can directly measure the modulus of geomaterials in situ using the built-in geophones and measuring the deflection of the surface under the drop of a weight from an adjustable height.



## GEOPHYSICAL TESTS

- » Geophysical tests represent an important class of field tests for determination of soil properties. These methods can be used for the location of different strata, contaminant plumes, underground services and for the evaluation of the subsoil characteristics rapidly and more economically than by borings.

### CAPABILITIES:

- » GPR (50, 100, 200 & 1000 MHz)
- » EM (0.5, 1, 3 & 6 m dipoles)
- » Seismic (12 Channel, Reflection, Refraction, marine survey)
- » Radio detection
- » LWD



## GEONICS EM38-MK2 AND EM31-MK2

The EM38-MK2 and EM31-MK2 provide measurements of both the quad-phase (conductivity) and in-phase (magnetic susceptibility) components within two distinct depth ranges, all simultaneously, without any requirement for soil-to-instrument contact.

- » ~0.5 m to 6+ m depth detection



## RADIO DETECTION (RD7100)

Radio detection  
RD7100  
Precision  
Underground  
Service &  
Utilities  
Locator.



## AUTOMATED AND TRADITIONAL OEDOMETER SYSTEMS

- » GeoComp and GDS systems provide a force control unit with displacement measurements taken from the platen movement. The labs also comprise traditional hanging weight oedometer frame.

### CAPABILITIES:

- » Load range up to 10 kN
- » Standard Cell Size: 50, 63.5, 70, 75 & 100mm
- » Axial compression
- » Stress and Strain control tests
- » Oedometer / Consolidation tests
- » Swell tests (constant load and constant volume)
- » Low speed/creep tests
- » Static load/displacement



## OTHER CONSOLIDATION TESTING SYSTEMS (ROWE AND BARDEN TYPE)

- » The test system is based on the Rowe and Barden type consolidation cell using pressure/volume controllers of different capacities and accuracies.

### CAPABILITIES:

- » Constant head permeability
- » Constant rate of loading
- » Constant rate of strain
- » Continuous infinite volume flow



## Small strain PIV



## GROUND PENETRATING RADAR (GPR)

- » Ground Penetrating Radar (GPR) with 50, 100, 200 and 1,000 MHz. GPS (~10m accuracy) and DGPS
- » (~1 to 10 mm accuracy), or odometer operated. Integration to GIS software and 3D visualization of stratigraphy, contamination, archeological artifacts, groundwater table, underground services and other targets
- » (e.g., voids, caverns, etc.).



## 100 KN CYCLIC ENVIRONMENTAL TRIAXIAL TESTING SYSTEM

- » The system can check the hydro-mechanical characteristics of rock/soil under high pressure, high temperature conditions; both static and cyclic loading conditions can be considered.

### CAPABILITIES:

- » UCS and triaxial tests
- » Static and cyclic loads control
- » Various cyclic waveforms: sinusoidal and user defined
- » Vertical load up to 100 KN
- » Sample sizes: up to 100 mm diameter
- » Vertical and lateral deformations

Large Scale Soil Testing Chamber (3x5x4 m) available in 2022



## OUR PROJECTS

### SOIL-STRUCTURE INTERACTION (MINI DRIVEN PILES)

This project investigates the load-carrying mechanism of a mini driven pile group system. It also monitors the strain profile along pile during loading, results are used to verify numerical models.

### ENERGY GEO-STRUCTURES

This project determines the thermo-mechanical response of piles, retaining walls, slabs that are thermally activated as part of shallow geothermal systems. Thermal yields and constructability are investigated.

### RETAINING WALL MONITORING

This project develops an effective monitoring system for retaining wall construction. It also monitors the field performance of retaining wall during construction and validates the design with monitoring data.

### WASTE TYRE PERMEABLE PAVEMENT

This project optimises the design of the Waste Tyre Based permeable pavements. It monitors the strain profile under traffic load at different depths of pavement.

### SOIL-STRUCTURE INTERACTION WITH OPTIC FIBRES

Optic Fibre sensing offers high spatial resolution, durability and resilience and is unaffected by electromagnetic fields. Optic fibre can be used to estimate:

- » strain
- » temperature
- » stress
- » bending moment

### PIPE-JACKING MONITORING

This project develops a novel monitoring system for pipe-jacking. It improves the pipe-jacking design by monitoring strain profile along pipe during pipe-jacking. It helps with understating of the permanence of Glass Reinforced Polyester (GRP) pipe.

### OUR CLIENTS AND INDUSTRY PARTNERS

- » GHD
- » Worley Parsons
- » Golder Associates
- » AECOM
- » Melbourne Metro Rail Authority
- » Ground Source Systems
- » Tyre Stewardship Australia



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