

School of Civil Engineering



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

CREATE CHANGE

Before you leave the laboratory:
Clear your workspace after you have finished your experiments.



Geotechnical Laboratories

Capabilities and Equipment

Summary

The Geotechnical Engineering Laboratories in the School of Civil Engineering at The University of Queensland (UQ) continue to develop a wide range of world-leading testing facilities.

We have a culture that promotes professionalism and creativity in all users of the laboratories. We aim to collaborate with other universities and industry partners to ensure the establishment of laboratory services relevant to meeting research and testing needs in Geotechnical Engineering.

Our facilities include custom-built equipment that covers a wide variety of soil and rock testing, and a capability to produce high-quality results for use in journal and conference papers, undergraduate and postgraduate research, and a growing number of commercial projects.

We partner with Universities and Industry both locally and internationally and are always looking for new mutually beneficial partnerships

Summary of Testing Abilities

Moisture content of a soil (AS 1289.2.1.1-2005)

Total suction by WP-4T

Specific Gravity with helium Pycnometer (ASTM D5550-14)

Particle size distribution by dry or wet sieving (AS 1289.3.6.1-2009)

Particle size distribution by hydrometer (AS 1289.3.6.3-2003)

Liquid Limit by Four-point Casagrande method (AS 1289.3.1.1-2009)

Liquid Limit by One-point Casagrande method (AS 1289.3.1.2-2009)

Plastic limit (AS 1289.3.2.1-2009)

Linear Shrinkage (AS 1289.3.4.1-2008)

Plasticity index (Includes 4-point Liquid Limit, Plastic Limit and Linear Shrinkage (AS 1289.3.3.1-2009)

pH value of a soil paste (AS 1289 4.3.1)

Electrical conductivity of water or soil paste

Standard Compaction (AS 1289.5.1.1)

Accelerated weathering - Slake Durability (ASTM D 4644-04)

Direct Shear multi-stage test - 60 x 60mm or 100 x 100mm (AS 1289.6.2.2)

Direct Shear multi-stage test - 300 x 300 mm

Triaxial consolidated undrained, with pore pressure (100 mm dia.)

Triaxial consolidated undrained, with pore pressure (38 mm dia.)

Unconfined Compressive Strength (includes sample preparation, up to 55mm)

Brazilian Indirect Tensile test (includes sample preparation, up to 55mm)

Oedometer - One dimension consolidation test (AS 1289.6.6.1)

Slurry consolidometer test

Soil Water Characteristic Curves (drying only)

Soil Water Characteristic Curves (drying and wetting)

Permeability of a soil by Constant head method (AS. 1289.6.7.1)

Permeability of a soil by Falling head method (AS. 1289.6.7.2)

Soil Testing

High stress consolidation testing

Purpose-built consolidation cell with 150 mm diameter by 150 mm high, and a maximum vertical stress of 10 MPa. Suitable for particle sizes up to 19 mm. The device is suitable for testing rockfill and mine waste rock to loading equivalent to up to 600 m of overburden.

Large-Scale Triaxial Testing

For testing soil specimens up to 100 mm in diameter and up to 200 mm high, up to 1,000 kPa cell pressure, under, saturated or unsaturated conditions.

Soil Water Characteristic Curves

This test simulates drying/wetting of tailings under applied pressure(suction) to measure moisture vs suction values on samples of 75 mm diameter and 25 mm height.

Instrumented large columns

Large columns for testing sediments and mine tailings from a slurry, including settling, self-weight consolidation, desiccation and re-wetting. Sensors include moisture, suction, temperature, salinity, gas, piezometers, inclinometers, and data loggers to replicate wetting/drying long term periods.

Electromagnetic and Hydraulic characterisation

(a) T5x tensiometers (measures suction up to 160 kPa); (b) UGT Polymer tensiometers (Measures suction up to 1,500 kPa); (c) Setup for measuring unsaturated hydraulic conductivity functions of soils; (d) Time domain reflectometry (TDR) setup comprising of pulse generator, sensor, and computer ; (e) Stabilized time domain reflectometry (STDR) comprising of pulse generator (SEQUID), calibration kit, coaxial cell, and computer; (f) Vector network analyser (measures complex dielectric spectrum with a frequency range of 50 MHz – 3 GHz).

Slurry consolidation testing

Purpose-built consolidation testing of soils from a slurry state, including tailings and dredged sediments. Dimensions of 150 mm diameter by 410 mm high, with a maximum vertical stress of 500 kPa (up to about 60 m depth of tailings). Instrumented with top and base load cells, and pore water pressure transducers at the base and 40 mm intervals up the side of the cell.

Filtration Cell

To apply controlled air pressure onto tailings samples in order to dry them out and collect the water coming out of them.

Large soil direct shear and pull-out testing

Large direct shear apparatus for shear strength and pull-out testing involving coarse-grained materials and geotextiles with 300 mm x 300 mm cross-section and 200 mm high. The machine can apply maximum normal stress of up to 4,000 kPa (for 150 mm specimens). The device is suitable for particle sizes up to 37.5 mm, and shear and pull-out testing of geotextiles.

Instrumented Column Testing

Column, and associated moisture, suction, temperature, salinity and gas sensors, and data logger, was developed at UQ as a “standard test” for assessing the settling, self-weight consolidation and desiccation of tailings slurry. It measures 1.2 m high by 200 mm diameter, is constructed in sections for ease of pouring and sample deconstruction and can be deployed in laboratory-simulated desiccation and re-wetting, and under atmospheric conditions in the field, with a weather station.

Large-Scale, Instrumented Field Column Testing

Large-scale field columns and associated moisture, suction, temperature, salinity and gas sensors, and data logger, for assessing covers for potentially contaminating waste rock.

Soil direct shear box and Consolidation

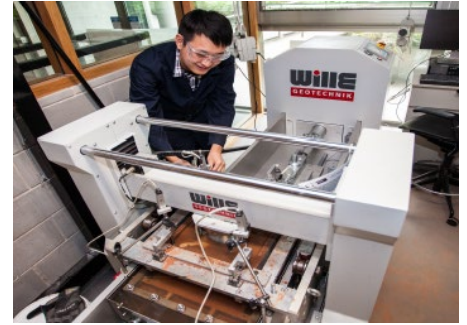
Saturated and unsaturated direct shear testing on 60 mm x 60 mm and 100 mm x 100 mm samples. Maximum shearing capacity is 1000 kPa (equivalent to up to 60 m of overburden). Consolidation can be performed by 75 mm and 71 mm diameter rings for up to 1,000 kPa at different loading rates.

Vane Shear

Vane shear test with 12.5 mm and 40 mm diameter vanes.

Monitoring of in-situ moisture and density of Geo-material

The Time domain reflectometry (TDR) device measures soil water content and dry density in a non-destructive way.



Rock and Shotcrete Testing

Hybrid True Triaxial/Biaxial Load Testing Facility

The True Triaxial Testing system can apply 21 MPa stress in three orthogonal directions on 200 mm cubic specimens (or up to 340 MPa on 50 mm cubed specimens). It is equipped with temperature (of up to 100°C) and relative humidity control, has the capability for testing under saturated and unsaturated conditions, and will have state-of-the-art monitoring equipment including acoustic emission and ultrasonic for the assessment of progressive damage processes. The system can perform rock permeability testing at up to 10 MPa pressure and hydraulic fracturing at up to 52 MPa on 200 mm, 100 mm and 50 mm cubic rock specimens in three directions.

The Biaxial Testing System can test slabs of up to 300 mm in-plane dimensions (i.e. 300 mm by 300 mm shells) and comes with 10 mm grips that makes it an ideal high-tech research testing rig for metals, fibre/resin composites, rocks and any other plate/shell materials. This machine is equipped with 4 x 250 kN actuators that can each be operated in either compression or tension to provide a diverse range of biaxial stress conditions. Moreover, the Biaxial machine can provide cyclic motion and single or repeated impact loads by means of 1 x 10 kN out of plane hammer with up to 4 m/s impact speed.

Conventional Triaxial System (Hoek-Cell)

The available Hoek cells accept 1.5" diameter samples (38.1 mm sizes), BX sample sizes (42.04 mm), and NX sample size of 54.7 mm. Each cell can operate up to 70 MPa of confinement, and the length can be up to twice the diameter of the specimen.

Rock preparation facilities

Our cutting machine can cut rock samples of irregular shapes, rock cores, as well as surfacing and machining the ends of the cylindrical or cubical samples. This machine is micro-processor controlled; front panel with touch pad controls and has a cutting capacity of up to 90/115 mm of solid stock, for cut off wheels of up to 250/300 mm in diameter and are twin T-slotted. The available grinding machine has two electronic motors and can be used for the vertical grinding and polishing of natural stones, concrete, as well as ceramic samples on two parallel sides. The coring device accepts sample sizes up to a maximum of 300x300x300 mm. Core barrels of diameter 18-150 mm can be used with the machine, with a barrel length of approximately 400 mm.

Stereo Ultra-High-speed camera facility

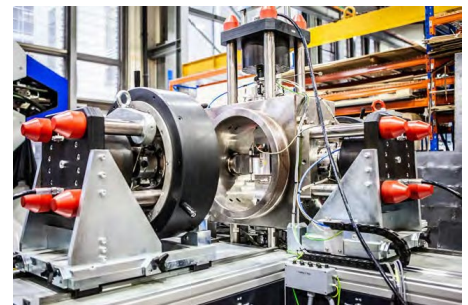
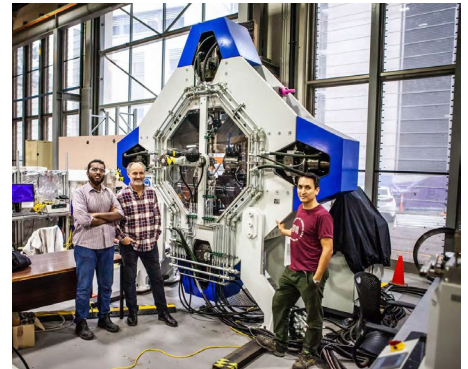
Our facility is equipped with a state-of-the-art stereo (3D) ultra-high speed and high-resolution camera facility capable of running at up to 1,000,000 frames per second, which makes it able to capture the high-speed fracture of brittle materials. With the aid of the 3D high speed photography and Stereo Digital Image Correlation (DIC) capabilities, quantitative measurement of static and dynamic deformation and cracking patterns in rock failure can be monitored.

Shotcrete toughness testing facility

Round Determinate Panel (RDP) test method can determine flexural and post-crack performance of fibre reinforced shotcrete. Toughness is expressed as energy absorption in the post-crack range using an Ø800/75 mm round panel supported on three symmetrically arranged pivots at the bottom and subjected to a central point load from the top. RDP test is often used to compare the effectiveness of additions of reinforcement fibres. There is potential to extend the diameter and enlarge the thickness of the panel to 1,200 and 150 mm, respectively.

Determination of the early strength of sprayed concrete with Hilti gun

The calibrated system consists of a stud driving gun and a tensile pull-out tester, which can determine early strength of shotcrete, especially for specimens with set accelerator. The results of a series of test can estimate strength development of shotcrete. Concrete strength can be converted from the ratio of measured pull-out load to penetration depth from calibration curves. It is capable of measuring concrete strength range from 2.0 to 16.0 MPa.



Learn more about our true triaxial load testing facility.



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