THE UC TRIAXIAL PERMEAMETER: A NOVEL GEOTECHNICAL TESTING APPARATUS FOR NEW ZEALAND EARTH DAM MATERIALS

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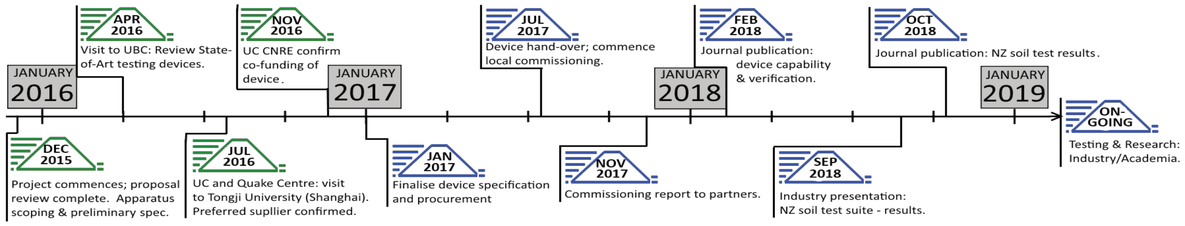
Design of a laboratory testing facility to address the impact of seismic events on the performance of earth dam materials.



Why earth dams?

Over 75% of dams in New Zealand are earth embankment dams, many of which were designed from the 1920s through to the 1980s to enable hydroelectric power generation and agricultural development, and to provide reliable water storage. New Zealand has around 150 large dams (over 15 metres in height, or retaining a volume of more than 1 x 10^6 m^3) which primarily serve the hydroelectric, agricultural and reticulated water supply sectors.

The Quake Centre Earth Structures research project was initiated to address an industry need for improved guidance on the evaluation of embankment dams subject to seismic loads.

What concerns do we face?

Many of the world's large earth dams were constructed before the evolution of current engineering design standards. A number of recent international sinkhole and erosion incidents suggest that some mechanisms of dam failure could take many decades to manifest at a visible scale. All over the world, the dam engineering community is calling for an improved science-based understanding of long-term earth dam performance.

Laboratory seepage testing is often recommended for soils used in critical embankment applications. To date, very few experimental studies have addressed the seepage performance of New Zealand soils, and appropriate testing equipment is not currently available in New Zealand. Specifically:

- New Zealand presently lacks geotechnical testing facilities capable of testing for particle migration and hydro-mechanical response in local earth dam materials.

Compounding these long-term performance uncertainties is New Zealand's highly seismic environment.

- There exists considerable uncertainty surrounding the behaviour of filter and transition soils during, and following, seismic loading.
- We possess a limited understanding of the response of earth embankments to successive periods of ground shaking – that is, the cumulative effects of earthquake events occurring throughout the entire life of the dam.

How will the UC Triaxial Permeameter address these concerns?

This project comprises the development, design, construction and commissioning of a 'dynamic' Triaxial Permeameter device. The device will be capable of state-of-art seepage testing for internal instability and filter compatibility, and will also incorporate a novel dynamic (simulated seismic) loading capability.

The UC Triaxial Permeameter will provide a local, specialized seepage testing facility in New Zealand, designed to accommodate challenging New Zealand earth dam materials. Specifically, the device will feature:

- Monotonic and cyclic (simulated seismic) testing capability.
- Large (300 mm) diameter test specimens: a scale sufficient to accommodate gravelly materials.
- Conventional permeameter (seepage) capability with triaxial stress control.
- Conventional triaxial testing capability, with or without seepage flow.
- A double-walled cell configuration to permit volume change measurements in unsaturated or transient flow conditions.

What are the expected outcomes?

The commissioning of a specialized seepage testing facility in New Zealand will develop expertise in the performance of soils subject to seepage and seismic loading, and provide local support to assist with the management of critical dam infrastructure.

Following fabrication and commissioning, the UC Triaxial permeameter will be made available for further specific research and contract testing of New Zealand dam soils.

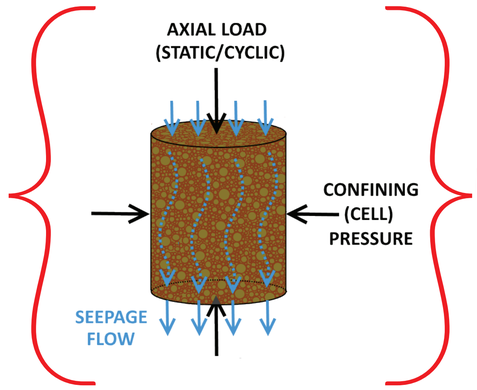
The project will grow dam engineering capability in New Zealand, both within industry and research faculty, and develop internationally-recognized expertise.

Who will benefit?

Research outcomes will set the stage for improved dam risk management across New Zealand in coming decades.

- **Asset owners** will benefit from reduced uncertainty in the assessment of earth dam performance, and will gain access to world-class local testing facilities for high-priority projects.
- The **academic community** will benefit from the concentrated investment of resources and expertise in the field of geotechnical dam engineering. Research collaborations will provide enduring links to the international dam engineering research community.
- The **New Zealand dam engineering community** will benefit from research outcomes and the development of local, world-class, capability in the field of geotechincal dam engineering.
- The **New Zealand public** will benefit by way of improved reliability of power and water supply, and safer dams.

2. WIDELY GRADED SOIL



3A. SPECIMEN SCHEMATIC

3B. LARGE SCALE SEVICE
(Example Load Frame)

Acknowledgements

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