

University of Pretoria Geotechnical Centrifuge Centre

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Website: <https://www.up.ac.za/civil-engineering/article/1914311/geotechnical-centrifuge-laboratory>

Owner: University of Pretoria, Pretoria, South Africa

Location: Hatfield Campus, University of Pretoria, Pretoria, South Africa

Introduction

The geotechnical centrifuge at the University of Pretoria is a model C67 Generation 4 centrifuge manufactured in 2011 by Actidyn in France. The capacity is 150 g-ton. The model platform measures 1.0 m x 0.8 m with 1.3 m of head space. The radius to the model platform is 3 m. The centrifuge is equipped with electrical, hydraulic, pneumatic and water slings which support a wide range of actuators to be used on models.

Data acquisition systems comprise the German HBM system, complemented by the Digidaq system from the University of Western Australia. The data acquisition systems allow a wide range of instruments to be monitored such as displacement and pressure transducers (piezometer and tensiometers, which we manufacture ourselves) and acoustic emission detection sensors (which we have logged at up to 192 kHz) and Tekscan TM pressure mats. We also make use of fibre optic strain measurement using Bragg gratings on the centrifuge.

Data is transmitted to the control room via a fibre optic rotary link which eliminates electronic noise associated with traditional electric slings. Models are observed using a range of webcam-based cameras in addition to a high resolution DSLR camera and a mono-chrome highspeed camera. The centrifuge is fitted with two solid state computers to manage data acquisition, actuator control and the cameras.

With our post graduate students, we have developed a few in-house micro-computer-controlled actuators and control systems for a range of centrifuge test purposes as described in the papers below:

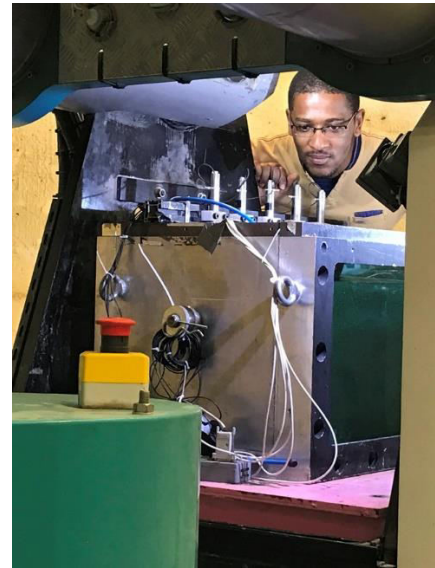
BROEKMAN, A., JACOBSZ, S.W., LOUW, H., KEARSEY, E.P., GASPAR, T.A.V. and DA SILVA BURKE, T.S. 2020. Fly-by-Pi: Open source closed-loop control system for geotechnical centrifuge testing applications. *HardwareX* 8 (2020). Elsevier. <https://doi.org/10.1016/j.ohx.2020.e00151>

BASSON, J.A., BROEKMAN, A. and JACOBSZ, S.W. 2021. A low-cost data acquisition system monitoring the unsaturated pore pressure regime in tailings dams. *HardwareX* 10 (2021). Elsevier. <https://doi.org/10.17605/OSF.IO/H9VBE>.

A number of actuators / instruments have been developed as listed below:

- High-capacity (50kN) vertical loading actuator to apply large vertical loads to model foundations.
- Two multi-purpose stepper motor controlled loading actuators / jacks.
- Horizontal and vertical cyclic load actuators to apply cyclic loads to piled and conventional foundations (refer to papers mentioned above).
- A laser surface scanner capable of 3D mapping soil surfaces in models.
- Miniature cone penetrometer (8mm diameter) measuring tip resistance for model characterisation.

A miniature piezocone (10mm diameter) has been ordered from the University of Western Australia (March 2023).



Key Technical Specifications

Beam Centrifuge	
Manufacturer	Actidyn, France
Model	C67 - 4
Year established	2012
Radius to base of soil container	3m
Capacity	150 g-ton (1.5 tons @100g, 950kg @ 150g)
Bucket area	1.0 m x 0.8 m
Major equipment	

Recent International Research Collaboration

Centrifuge modelling on foundations under alternating loads in overconsolidated clay, with Kassel University funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - RE 3881/4-1.

The Engineering and Physical Sciences Research Council (EPSRC – UK; Grant Ref: EP/P029434/1) funded the Wind-Africa project which investigated aspects of the behaviour piled wind turbine foundations founded in unsaturated swelling soils in collaboration with the Universities of Durham and Cambridge.

Modelling cave mining in the geotechnical centrifuge in collaboration with the Australian Centre for Geomechanics at the University of Western Australia.

For more information about the geotechnical centrifuge or for potential collaboration please contact Prof SW Jacobsz (sw.jacobsz@up.ac.za).