TIWTE Geotechnical Centrifuge Centre

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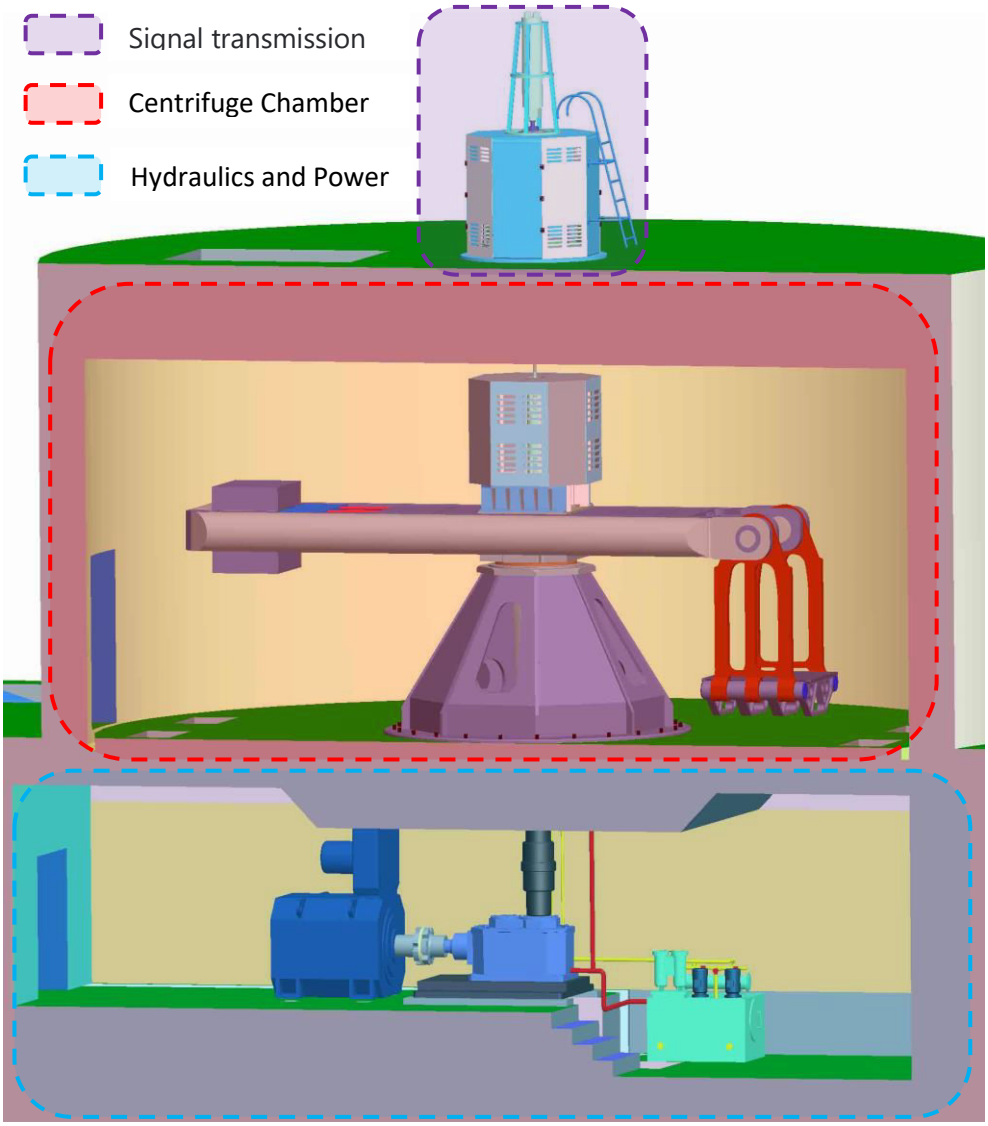
Introduction

Physical modelling is indispensable to derive insights on the key factors affecting the performance of geotechnical systems, to properly validate numerical models, and to evaluate the efficiency of innovative solutions (proof-of-concept). The TIWTE Geotechnical Centrifuge Centre encompasses a 10 m diameter (500 gton capacity) beam centrifuge, a cutting-edge earthquake simulator, a wave-generator, and a variety of actuators, tool platforms, and highly specialized devices and sensors. Our experimental infrastructure is predominantly used for research purposes. On demand, we also offer highly-specialized consulting services to the industry.



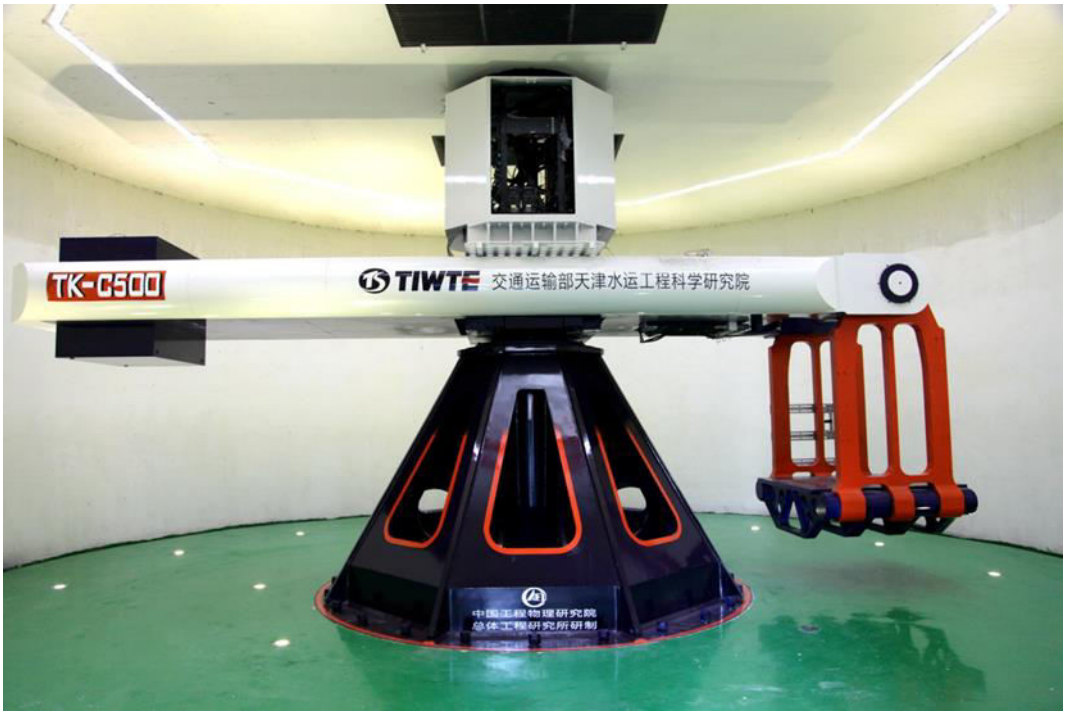
The TIWTE Geotechnical Centrifuge Centre .

Key Technical Spefications

Beam Centrifuge	
Manufacturer	China Academy of Engineering Physics
Year established	2018
Radius to base of soil container	5 m
Capacity	500 gton (5 tons @100g, max G-level: 250g)
Bucket area	1.4 m x 1.5 m
Major equipment	Earthquake simulator (capacity 0.8 tons) Wave-generator 3DOF Robotic loading system

Beam Centrifuge

The beam centrifuge consists of an arm supporting one swing and one fixture, in which the model and the counterweight are installed. It is connected to the chamber with a bottom and a top bearing, ensuring higher stability of operation. The centrifuge is brand new. The TIWTE geotechnical centrifuge is manufactured by the Chinese Academy of Engineering Physics. The geotechnical centrifuge centre was completed and put into use in 2018. It is an important part of the National Engineering Research Centre of hydraulic building Technology.



TK-C500 geotechnical beam centrifuge installed at TIWTE.

With an effective diameter of 9 m, the centrifuge can be accelerated up to 250g carrying a payload of 2 tons (or equivalently 5tons at 100g). Its 500gton capacity is the largest in China and one of the biggest in the world. A key advantage of the beam centrifuge is that the model can be installed without 90^{o} rotation (as in the drum centrifuge), thanks to the swing which rotates progressively with the increase of the g-level. As a result, the model base is always perpendicular to the acceleration vector. Each swing has a platform of 1.4 x 1.5 m, where the soil container is placed. The setup offers the possibility of a soil container of up to 1.2 m length, allowing testing large models corresponding to up to 300 m length (at the maximum g level).

Earthquake Simulator

Custom-designed for the TIWTE centrifuge, the earthquake simulator is capable of delivering horizontal seismic ground motions of any target waveform (including recorded and artificial motions) at up to 0.5 g peak ground acceleration on packages of up to 700 kg over a wide frequency band, at a maximum centrifugal acceleration of 100g. This new earthquake simulator is specially-designed to be easily mountable on the TIWTE centrifuge swing, without the need for extensive interventions. Moreover, it features a bi-directional actuator at the base, allowing the layer box to move in both lateral and vertical directions at the same time. This special feature offers the possibility to input a two-way ground motion, which can be crucial for testing soil-structure interaction with two-way ground motion.

Schematic of the centrifuge earthquake simulator.

The table is supported by six sets of preloaded rectangular elastomeric bearings, designed to withstand very high compressive loads. Local accumulators are installed at the edges of the earthquake simulator, aiming to provide compact packaging that minimizes piping lengths and pressure drops when high flow rate and pressures are required. The external hydraulic power supply includes a hydraulic pump, an oil reservoir, a set of accumulators, and an automatic control system. The high-pressure output and low pressure return lines are routed to the centrifuge arm through a set of high pressure hydraulic rotary joints.

Earthquake simulator	
Payload capacity	800 kg
Max. shaking acceleration(lateral)	40 g
Max. shaking acceleration(vertical)	20 g
Max. shaking velocity	0.5 m/s
Max. shaking displacement	±5 ㎜
Shaking frequency range	20-250 Hz
Max. shaking time	3 s