

NYUAD Abu Dhabi Geotechnical Centrifuge Test Facility

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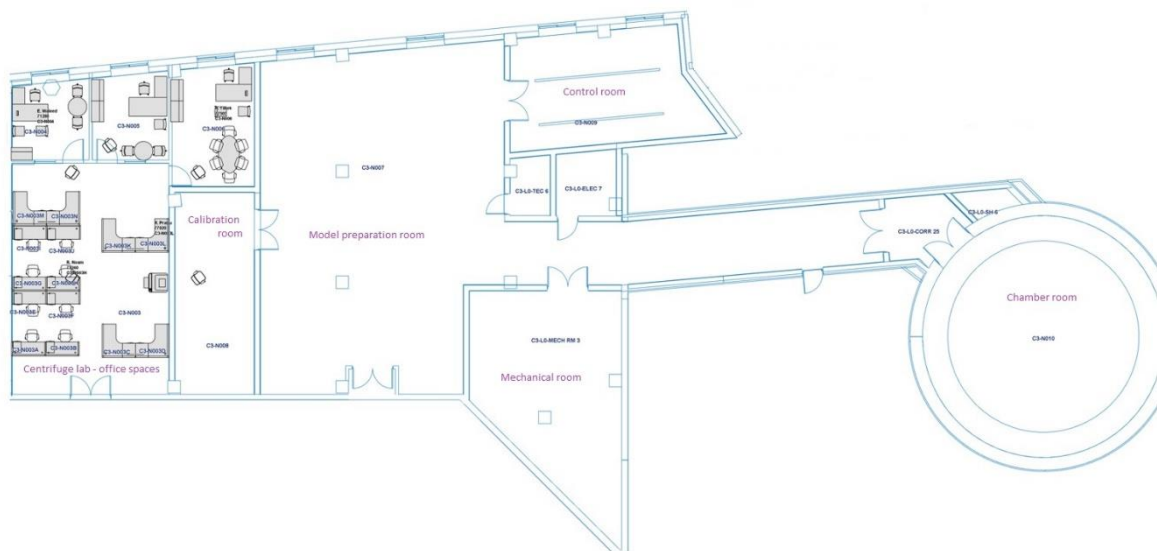
Website:

Owner: New York University Abu Dhabi

Location: Abu Dhabi, UAE

Introduction

The NYUAD Geotechnical Centrifuge Centre has the newly installed 5 m radius (260-ton capacity) basket centrifuge, Earthquake simulator, Two-axis loading system, High frequency one-directional dynamic loading system, and highly specialized devices and sensors. Our experimental infrastructure is predominantly used for research and teaching purposes. On-demand, we also offer highly specialized consulting services to the industry.



The NYUAD Geotechnical Centrifuge Test Facility

Key Technical Specifications

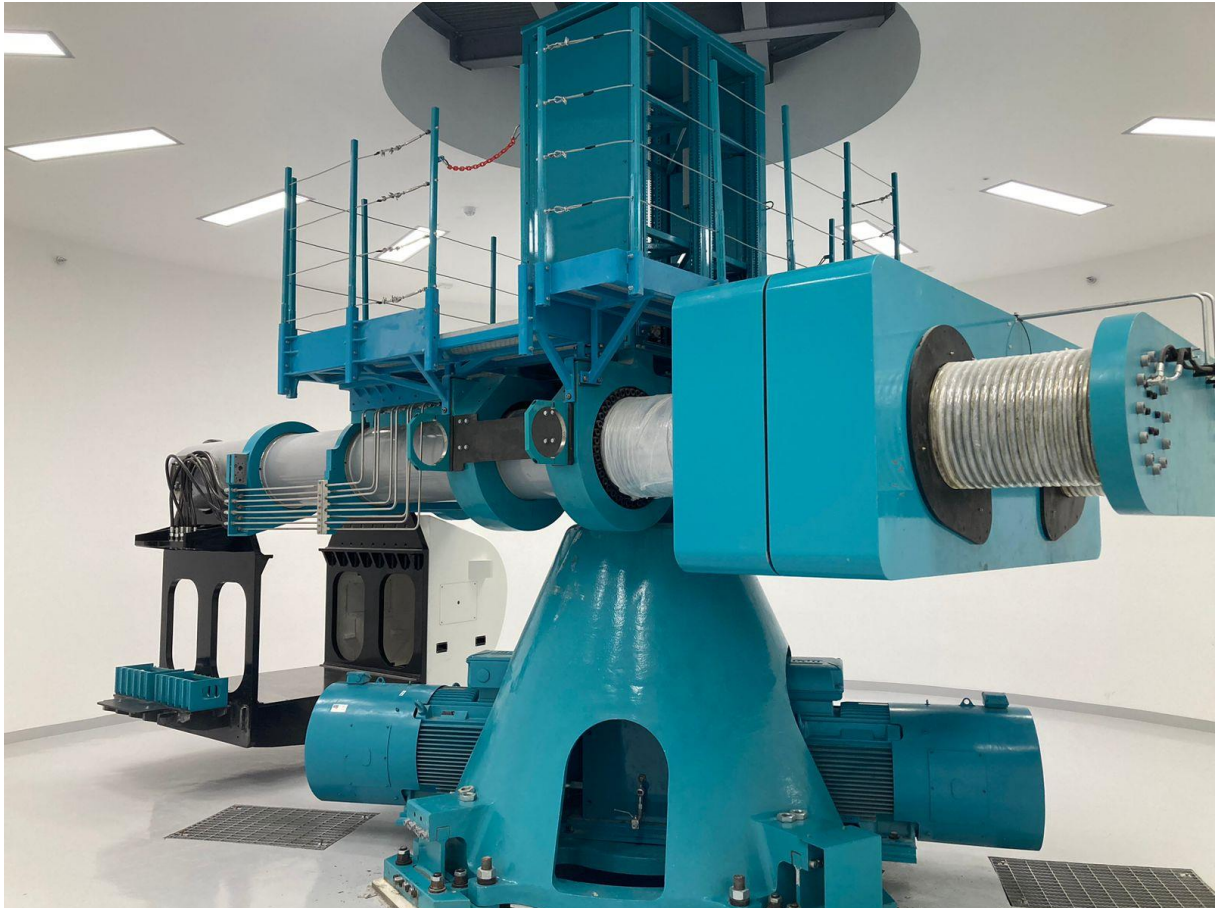
Beam Centrifuge	
Manufacturer	ACTIDYN, 78990 ELANCOURT, France
Year established	2023, NYUAD, Abu Dhabi
Radius to base of soil container	5 m
Capacity	260 gton (2.6 tons @100g, max G-level: 130g)
Basket test area	1.3 m x 1.3 m
Major equipment	Earthquake simulator (capacity 0.7 tons @100g) Two-axis loading system High-frequency dynamic loading system

Basket Centrifuge:

The NYUAD centrifuge is specifically designed for geotechnical applications and consists of a boom equipped with a pendulum swinging basket that rotates in a cylindrical enclosure made of concrete masonry, which performs both safety and aerodynamic duties.

The NYUAD geotechnical centrifuge has an automatic balancing system, power slip rings, a Fiber Optic Rotary Joint (FORJ) for data transmission at up to 1 Gbit/s, hydraulic rotary joints, and power slip rings.

Once the testing model is loaded on the basket, everything becomes automatic. Lock the chamber room doors, launch the controller on your control PC from the control room, and activate all secondary devices with all safety measures enabled.



With its 5-meter radius at the basket, acceleration is uniform over almost the entire 1.3m x 1.3m surface of the basket. The 2,600 Kg payload can be accelerated up to 100g, allowing users to design the most complex structures on foundations. At 130g, you can load up to 1,400 kg.

Our basket centrifuge is equipped with a QS72 earthquake simulator and is capable of simulating seismic vibrations in a few hours at the scale of your model.

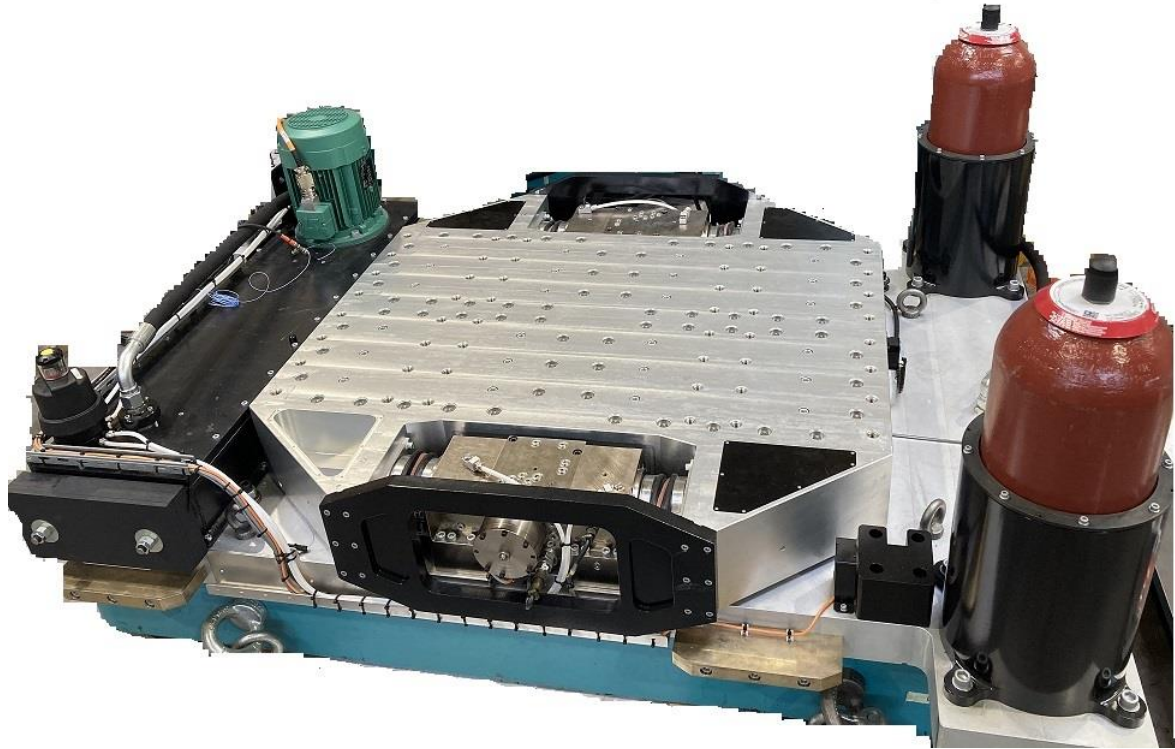
We can simulate road construction work, embankment, construction, and perform in-flight measurements over more than 0.6m of your model at 3-digit acceleration levels.

The setup offers the possibility of a soil container of up to 1.25 m in length, allowing testing large models corresponding to up to 163 m in length at the maximum g level.

Earthquake Simulator

The single-axis earthquake simulator is mounted on the centrifuge's basket with an optimized design in terms of mass and inertia. The NYUAD Earthquake Simulator operates on payloads of up to 700 kg, bringing them up to 100 g.

In sine mode with no load, it is capable of generating 60 g tremors and up to 20g at full load. The frequency range of the generated tremors – which can reach up to 5mm in amplitude 1.1m/s in speed – ranges from 40Hz to 350Hz. This occurs without ever affecting any single part of the centrifuge thanks to the complete decoupling of your model from the arm of your centrifuge.



The earthquake simulator consists of

- a flat steel base with optimized mass in order to increase the basket reaction mass
- A pair of integrated hydraulic actuators with high-frequency servo valves and local accumulators
- A large slip table made of Aluminum decoupled to the base plate by a set of sandwich elastomer pads
- A scavenging pump for oil drain return flow allows continuous operation

The slip table is supported by a set of preloaded sandwich pads made of several layers of elastomer bonded to flat, parallel metallic plates. They are designed to withstand very high compressive loads. The hydrostatic bearings eliminate backlash, hysteresis, nonlinearity, and noise that plague typical multi-actuator systems. This simplifies the control problem dramatically and improves the test results substantially.

The hydraulic loop controller compensates for the hydraulic circuit resonant frequency and provides a stable large bandwidth power actuator. The acceleration feedback signals are derived from two piezo-electric accelerometers that are located on each side of the shaking platform near the servo actuators.

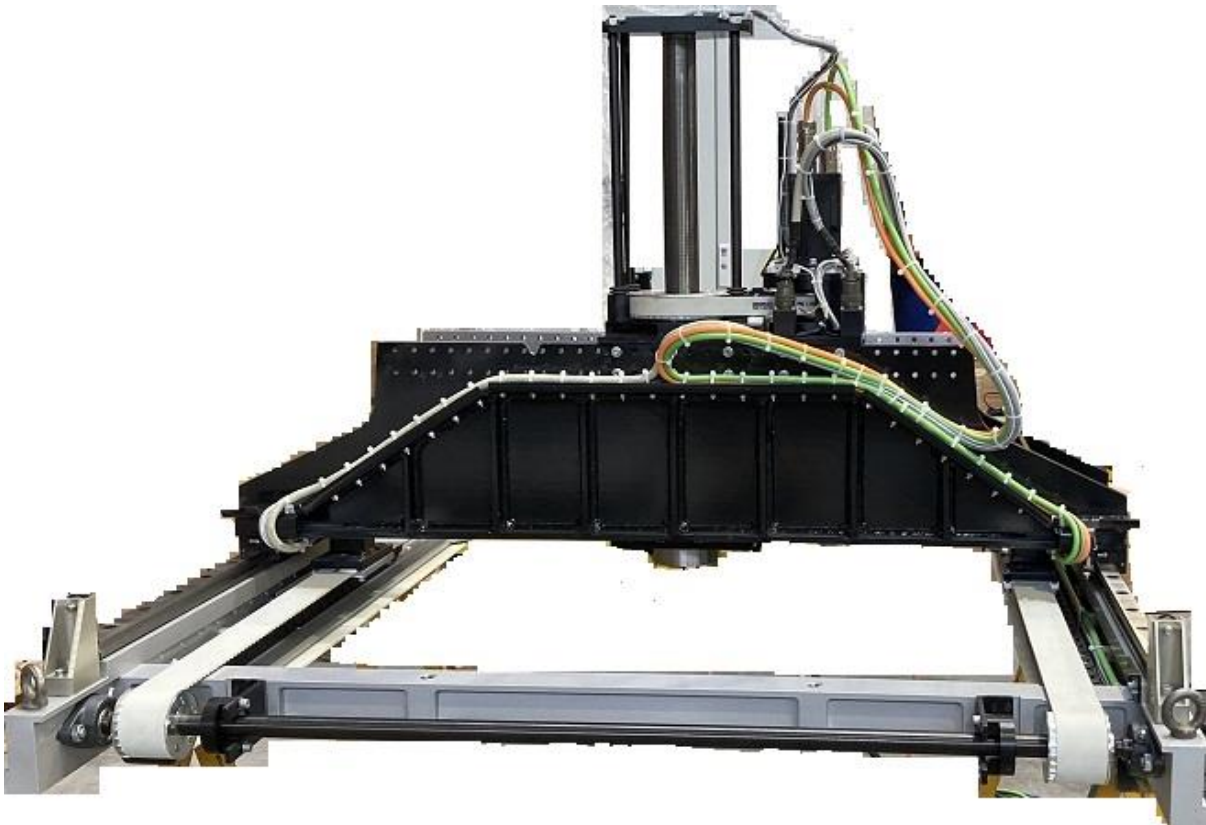
The SignalStar MATRIX dual-axis digital controller and function generator is a dedicated digital control that unites the all-new ABACUS DSP-centric hardware platform with the highly acclaimed Data Physics vibration control software to produce a complete and fully integrated solution redefining the boundaries of vibration testing.

Two-axis loading system

The Foundation loading actuator is a high accuracy large force bi-directional actuator. The actuator is remotely controlled from the main centrifuge controller and its associated operator P.C. The actuator controlling signal generated by the centrifuge controller is routed to the actuator AC power controller through dedicated slip rings.

Actuator force command and readout, force profile versus time are directly programmable and observable from the centrifuge operator PC during or independently of the centrifuge operation.

The system is fully calibrated, and tool mass is automatically compensated by the actuator control software.



The robotic loading system operates along 4 axes: two perpendicular translation axes in a plane parallel and above the bottom of the centrifuge basket, a dual axis of translation-rotation perpendicular to the aforementioned plane, able to produce up to 5kN, and a torque of up to 5N.m.

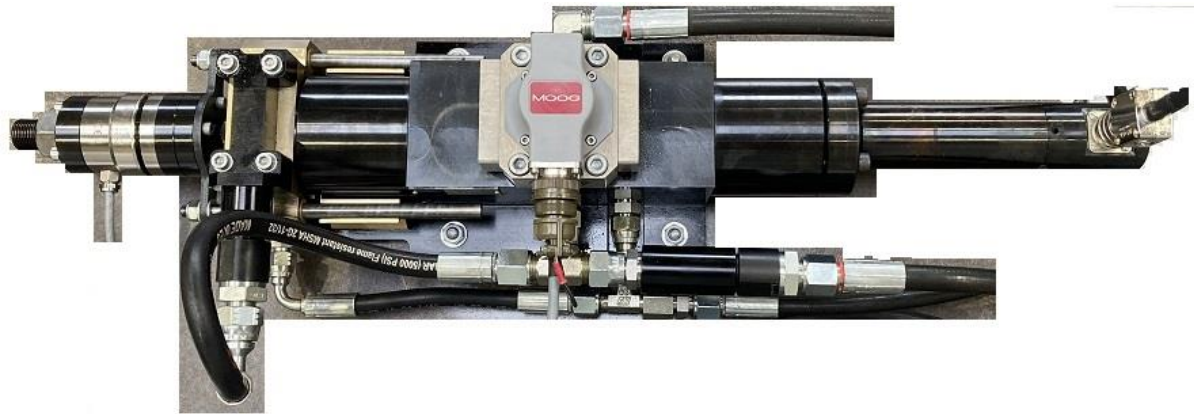
Allowing it to operate with speeds at 100g of up to 50mm/s and a positioning accuracy within 1mm on each axis and 1 degree on the rotation axis.

- X axis: Travel range - 800mm, speed- 50mm/sec
- Y axis: Travel indexing length - 600mm, 7 positions at 100 mm indexing step distance
- Z axis: Travel range - 490mm, speed- 5mm/sec, Pulling force - 10kN, Pushing force – 30kN
- Theta Zaxis tool: Torque - 5N.m., rate – 200 °/sec

High-frequency dynamic loading system

The high-frequency one-directional loading system is suitable for applying a dynamic variable force to a foundation's bearing or structure. This apparatus is designed for testing foundations bearing or piles under vertical forces.

The system is designed to operate tests under acceleration up to 100 g. It is capable of delivering up to +/-10,000 N force.



The dynamic loading force is generated by a hydraulic actuator mounted on a rigid beam with low deflection under accelerated gravity. The hydraulic actuator is equipped with a servo valve, a position transducer (LVDT), and a force transducer. The servo loop system, which controls the actuator, consists of a servo-valve amplifier and a vibration control system.

The MOOG programmable vibration controller supervises the axis loop controller and executes all measurements, readouts, and safety tasks. The control strategies are position and force loop control. Both modes are switchable in flight. The available excitation modes are fixed frequency sines, square, saw tooth, and sweep sines.

- Applied force: 10kN
- Displacement: 25mm
- Velocity: 390 mm/sec
- Frequency: 2Hz to 40 Hz