The 1985 service start-up of a centrifuge at the Laboratoire central des ponts et chaussées (LCPC) represented a tremendous innovation regarding studies and research conducted in the area of macrogravity. These days, the physical modelling of geotechnical structures using a centrifuge has become a widespread experimental approach.

This approach makes it possible to study the behaviour of geotechnical structures, such as foundations, offshore anchorages, tunnels, embankments or retaining structures, with reduced-scale models; its application is now routine for the purpose of obtaining experimental data either difficult to generate in situ or derived from parametric studies mainly carried out with problem set-ups involving soil-structure interactions.

The centrifugation of reduced-scale models allows reproducing stress states similar to those acting upon the full-scale prototype structure. Once conditions of mechanical similitude have been met, the obtained experimental data may be either extrapolated directly to the true-scale prototype structure or compared with numerical model results.

Loads are applied in flight using jacks or a on-board robot or the earthquake simulator, all devices being controlled remotely from the centrifuge operator’s room.

The scale-reduction factor is equal to the centrifugal acceleration being applied, up to a maximum of 200 g.
Technical characteristics

Dimensions
Centrifuge basket platform offset from the axis: 5.50 m
Rotor length: 6.80 m
Centrifugation room diameter: 13.50 m
Centrifugation room height: 3.90 m
Pivoting basket:
- platform length: 1.40 m
- platform width: 1.15 m
- clearance height: 1.50 m

Performance
(Maximum) model mass: 2,000 kg
Maximum acceleration (at 5 m): 200 g
Allowable unbalanced mass: +/- 100 kN
Run-up time at 200 g: 360 sec

Connections with the model
Low-level slip-rings: 101
Power slip-rings: 5
Hydraulic joints: 6
IEEE488, RS485 and fibre optic connections
CCD cameras and image processing system

A special building houses the centrifuge and a total of 900 m² are devoted to this activity: rooms assigned to model preparation, material conservation, mechanical and electronic shop area, as well as a small soil mechanics laboratory.

A wide range of applications both in the geotechnical field and in other disciplines for conducting research on various physical phenomena influenced by gravity

Suction-activated offshore anchorages
Deep-water foundations
Shallow foundations
Shallow foundations on unsaturated soils
Deep foundations subjected to static or cyclic loading
Micropiles and screw piles
Soil reinforcement
Shallow tunnels
Retaining walls
Dyke erosion
Vibration barriers
Pollutant migration
Earthquake simulation
Model calibration and improvement of investigation methods
Aerospace equipment certification under constant acceleration
Certification of sensors (force, pressure, stress)
Stresses and flows of granular materials
Crystalline growth and combustion

Main partners in the geotechnical field
Bouygues Offshore, C-Core (Canada), Cermes, Chevron, Ecole Centrale-Nantes, Exxon, GDS, GeM, Geodia, the Vinci Group, Ifremer, IUT Saint-Nazaire, SBM, Sétra, Total, University of Athens, University of Bochum, University of Dundee, Durham University, University Los Andes - Bogota, University of Milan, University of Nantes, Université politécnica de Catalunya (Barcelona), Université Sao Carlos (Brazil), Bucharest Building Engineering School.

Other partners
Aérospatiale, CNRS Meudon, Ecole Centrale-Paris, In-Flex, LMS-EP, Paris VI, Ratier Figeac, Turbomeca, Brunel University (U.K.), University of Poitiers.