DTU Geotechnical Centrifuge

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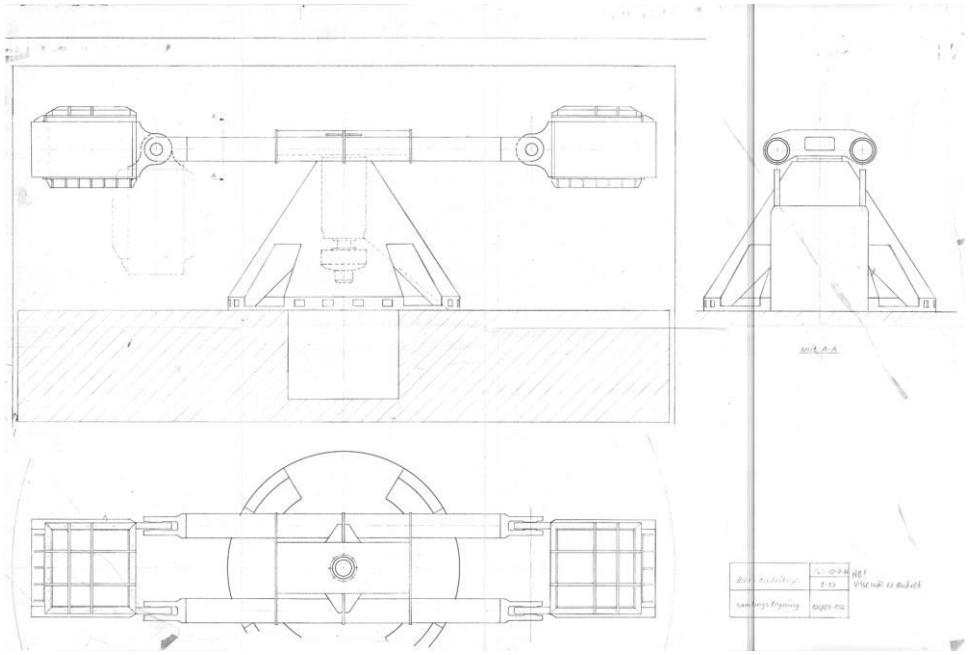
Introduction

The Technical University of Denmark (DTU) operates a geotechnical beam centrifuge as a part of the Laboratory of Geomechanics and Geotechnical Engineering (Geo Lab). The centrifuge was built in 1976 and has been upgraded over the years, latest with onboard data acquisition and control systems. It is, a 5.2 m diameter (100 gton capacity) beam centrifuge equipped with a variety of actuators, specialized devices and sensors. The centrifuge is housed at the basement of 60m^2 of a building, where the ground floor 47m^2 is allocated for sample and model preparation, and two small rooms are used for control and operation (8m^2). Our experimental infrastructure is predominantly used for research and teaching purposes, while the experimental activities are usually supplemented by soil characterization and element mechanical testing.



The Geotechnical Centrifuge at DTU. Blueprints of the original construction drawing.

Key Technical Spefications

Beam Centrifuge	
Manufacturer	H. Nielsen
Year established	1976 Technical University of Denmark (DTU)
Radius to base of soil container	2.6 m
Capacity	100 gton (1 tons @100g, max G-level: 85g)
Cylindrical bucket size	0.52 m x 0.50 m (DxH)
Rectangulal bucket size	0.70 m x 0.50 m x 0.70m (HxWxL)
Major equipment	Setup for consolidation of clay samples
	2DOF loading system

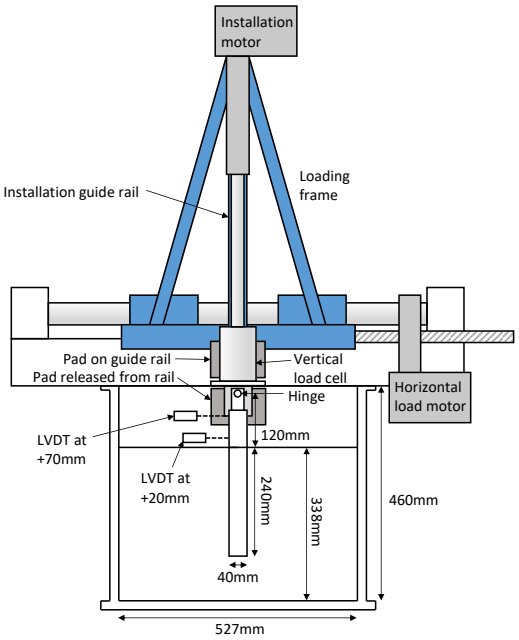
Beam Centrifuge

The beam centrifuge consists of an arm supporting two swings, 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 equipment has been upgraded over the past years with the first major renovation taking place in 1999 and financed by the Corrit Foundation. New control and on board data logging systems were installed in 2005.

The geotechnical beam centrifuge installed at DTU.

With an effective diameter of 5.2 m, the centrifuge can be accelerated up to 85g (or equivalently 1ton at 100g). A key advantage of the beam centrifuge is that the model can be installed without 90^{o} rotation, 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 0.70 x 0.5 m, where the soil container is placed. The soil samples are prepared and saturated in the preparation room, where clay samples are consolidated by one dimensional compression, sand samples with a spot pouring hopper, and silty sand samples by compaction.

Besides the data acquisition system and the on-board computer, the tool platform is equipped with vertical and horizontal servo-electric actuators. They are fixed on a rigid frame that ensures high loading capacities, allowing for example on flight installation of piles (Truong et al 2019). The actuators are equipped with load cells and displacement transducers to control and measure the results of the test. A mini-penetrometer (CPTu) from Istituto Sperimentale Modelli e Strutture, Bergamo Italy (ISMES) is frequently utilised for in situ characterization of the soil sample.



Load frame installed on the top of the cylindrical soil container. The frame is equipped with two actuators that apply controlled loading in the vertical and horizontal direction. Sketch of the setup after Truong et al. (2019)