Science Tokyo Mark III Geotechnical Centrifuge

Director: Prof Akihiro Takahashi
Manager: Mr Sakae Seki
Contact: Prof Akihiro Takahashi (takahashi.a.3a81@m.isct.ac.jp)
Website: https://sites.google.com/view/geotech-cv-titech/
Owner: Institute of Science Tokyo (formerly, Tokyo Institute of Technology), Japan
Location: Meguro, Tokyo, Japan

Introduction

Physical modelling using a geotechnical centrifuge at Tokyo Institute of Technology started in 1968. It was the second centrifuge in Japan after the one at Osaka City University in 1965. The first beam-type centrifuge with a radius of 1.4 m was installed in 1970 (Mark I) and was mainly used for bearing capacity problems. The second centrifuge (Mark II), installed in 1981, was used for various geotechnical problems using an in-flight sand hopper, an excavator, and shake tables. The third one (Mark III) has been actively used since 1994. Its relatively large bucket enables us to accommodate a wide range of testing equipment and systems, thereby facilitating the solution of various geotechnical and environmental problems under diverse conditions. This centrifuge was relocated to the current Department of Civil and Environmental Engineering Building in 2023. In 2024, the institute's name changed to the Institute of Science Tokyo (Science Tokyo) following its merger with Tokyo Medical and Dental University.

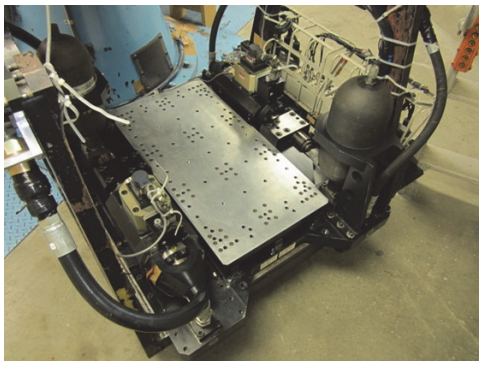
Science Tech Mark III Geotechnical Centrifuge

Key Technical Specifications

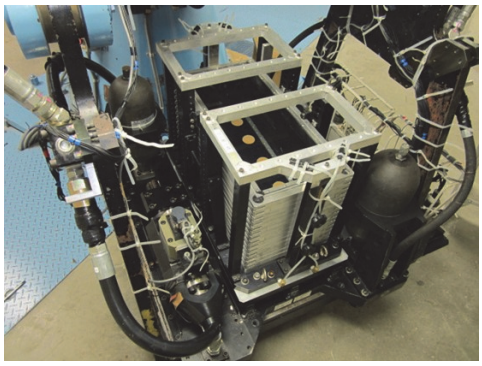
Beam Centrifuge	
Manufacturer	Tama Kosaku-sho / Maintained by Nippon Steel Railway Technology
Year established	1994 / Relocated in 2023
Platform radius	2.32m
Capacity	50 G ton
Bucket area	0.9 m x 0.9 m
Major equipment	Shake table Dip-fault simulator Rainfall simulator Flood simulator including an in-flight water circulation system

Shake table

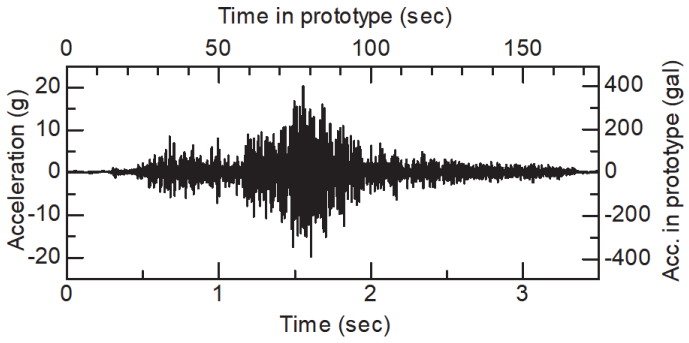
The current shake table for the Mark III Centrifuge is the fifth one at Science Tokyo. This can accommodate a 200 kg model at 50 g and can reproduce strong and long earthquake motion as shown in the record below. Maximum displacement, velocity, and acceleration are 6 mm, 700 mm/s, and 35 g (at 100 Hz), respectively. The frequency range is from DC to 200Hz.



Shake table on platform.



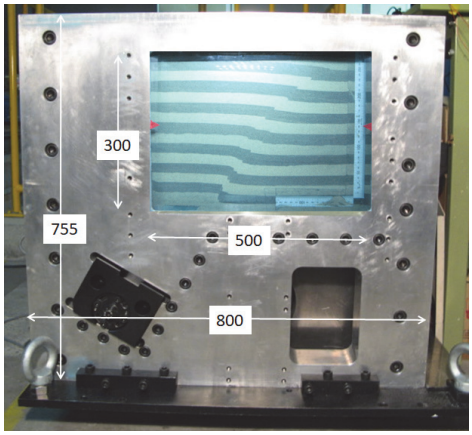
Shake table with laminar box.



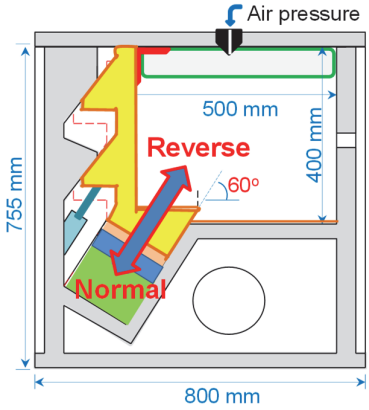
Example of earthquake motion at 50 g (2011 Tohoku Earthquake)

Dip-fault simulator

This fault simulator is used to study the behaviour of buried structures in soils over dip-slip faults. This can generate both normal and reverse faulting and can function for reverse faulting conditions under 50 g with a surcharge pressure of 500 kPa. The maximum offset of 30 mm with a dip angle of 60° can be achieved at the bottom of the model soil.



Front view of fault simulator.



Schematic diagram of cross-section.

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