Dynamic Geotechnical Centrifuge (unidirectional shaking table)

Background

Safety reviews of nuclear power facilities in accordance with the new regulatory requirements are being carried out by the Nuclear Regulation Authority (NRA), Japan. The NRA requires the determination of highly accurate design basis seismic ground motion and three-dimensional evaluations of the subsurface structure beneath the sites in the design of S-class buildings and structures, classified according to importance of seismic design. Furthermore, periodic safety reviews for NPPs are also required after NPPs recommence their operations. The NRA requires these periodic safety reviews to induce probabilistic risk assessment for NPPs, and this involves assessing the health of NPPs and their respective foundation ground. In order to meet those requirements, the development of two numerical analyses is urgently needed. One is a non-linear time history response analysis evaluating a failure zone and residual deformation of the ground. The other is a distinct element method assuming rock mass collision and rebinding during a slope collapse. The NRA requires verification of these new analyses methods through experiment. To carry out the verification test, CRIEPI has installed a Dynamic Geotechnical Centrifuge. On the basis of the scaling lows of centrifugal force field, the seismic behavior of the model is identical to that of the prototype.

Outline

This facility is composed of a unidirectional shaking table, a container with specimen, and dynamic data loggers, which are placed on the platform of a Static Geotechnical Centrifuge (facility name; Geotechnical Centrifuge System "CENTURY5000-THM") installed in 2009. For example, shake table tests of maximum ground acceleration form 500 gal to 1000 gal (the frequency of about 0.4~8 Hz) can be performed for 1/25~1/50-scale model of the ground. The dimension of the shaking table is 30 cm × 70 cm.

Specifications

[Location and date of installation]

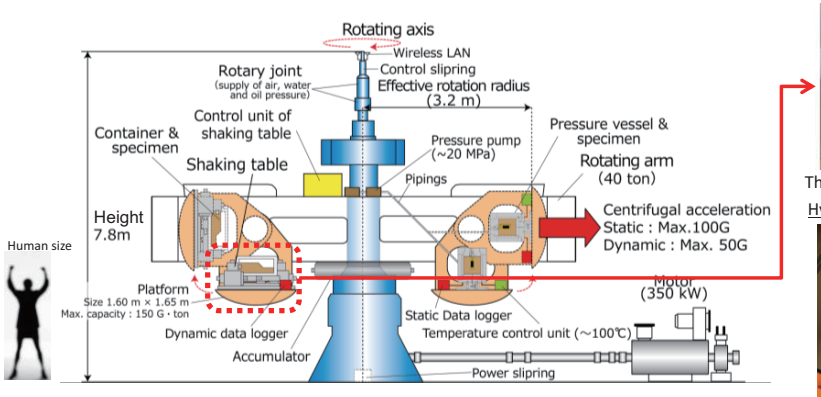
Abiko area / February 2015

Table 1: Specifications of Shaking Table

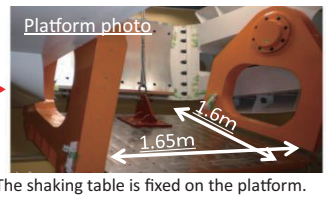
Shaking direction	Horizontal
Centrifugal acceleration	25-50G
Max. shaking acceleration	±35G
Max. shaking velocity	±80cm/s
Frequency range	10-400Hz
Wave shape	Seismic wave, sine wave
Dimension of shaking table	30 × 70cm

Table 2: Scaling Laws for 50 G Centrifuge Test

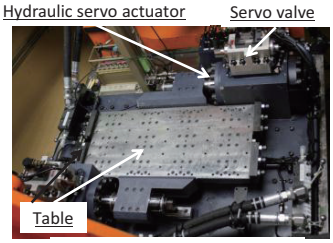
Physical property	Full-scale	Model
Size	1	1/50
Stress	1	1
Strain	1	1
Time	1	1/50
Acceleration	1	50
Frequency	1	50



Platforms are swung up by rotating arm and centrifugal acceleration acts on the specimens on the shaking table.



The shaking table is fixed on the platform.



Shaking table system photo

Fig. 1: Dynamic Geotechnical Centrifuge