

Earthquake Observation Record and Simulation Analysis in a Building named "Chisuikan" using Three-dimensional Seismic Base Isolation System

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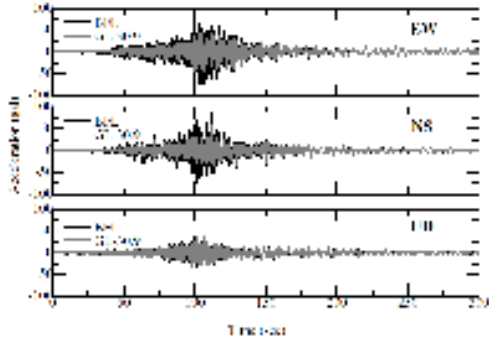
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SUMMARY

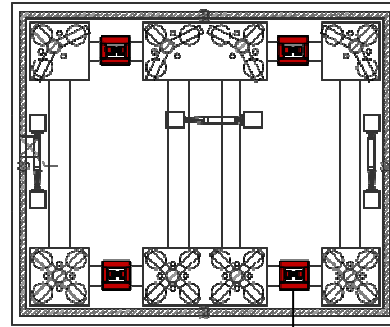
The authors have been reporting development of a three-dimensional seismic base isolation system that is capable of seismically isolate the horizontal and vertical motions at the same time, as well as ideas on the design upon applying such system. The building using the three-dimensional seismic base isolation system was completed on March 3, 2011, and named as "Chisuikan" which Chinese characters "Chi" (=knowledge or intelligence) and "Sui" (=seasoned and excellent technology) were gathered in the "Kan" (=building) as a fruit of the project. In this paper, we report the vibration testing and the observation record in the 2011 off the Pacific coast of Tohoku Earthquake in "Chisuikan".

Vibration testing was conducted when the framework of the building was completed in December 2010. The purpose of this testing was to confirm seismic isolation efficacy on vertical and rocking vibration on the overall building. Free vibration test was conducted rapidly releasing the jack oil pressure in the overall building in the case of vertical vibration, and in one side of the building in the case of rocking vibration with the jack-up, respectively. The first vibration period in the vertical direction obtained from the measurement results in the testing was almost consistent with the first vibration period obtained from the numerical analysis at the time of design. High damping effects were also successfully confirmed in regards to damping characteristics. Regarding to the rocking vibration intrinsic problem in the three-dimensional seismic isolation, it was successfully confirmed that the damping effects on the rocking vibration with the oil damper system was functioning, by comparing the response at the superstructure between the case that the oil damper system with rocking suppression is arranged at the four corners of the building with the case where there is no such oil damper system.

Also, it was a coincidence that the 2011 off the Pacific coast of Tohoku Earthquake occurred at 14:46 on March 11, only 8 days after the completion of "Chisuikan". The "earthquake observation system" in "Chisuikan" activated at 14:46:24. The measurement lasted for a very long time: a total observation record of 672 seconds. The "earthquake observation system" in "Chisuikan" consists of accelerographs placed within the building on RF, 1F and BF (seismic pit floors) as well as in the ground at the GL-30m location. Strain gauge and pressure gauge at seismic isolators, and horizontal and vertical displacement meters is set up on the seismic pit floors. Seismic characteristics and adequacy of analysis methods assumed at the time of design are covered in this report, by analyzing earthquake motions actually measured in Asagaya, Suginami-ku, Tokyo where "Chisuikan" was built, confirming the efficacy of the three-dimensional seismic system.



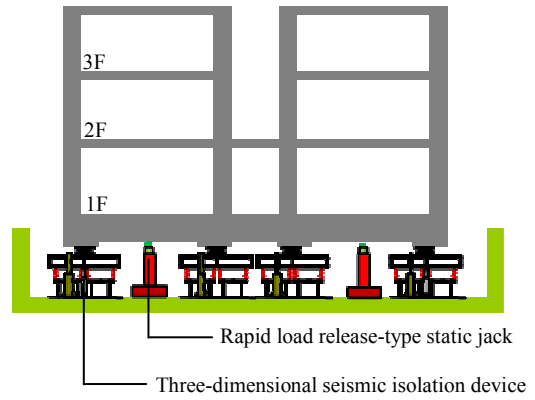
Observation Record



Jack mounting frame



Seismic Pit Floor



Rapid load release-type static jack

Three-dimensional seismic isolation device