

New evaluation methods for performance of seismic isolation bearings subjected to long duration earthquakes

Nobuo MUROTA, Takahiro MORI, and Sadamitsu TAKEUCHI
Seismic Isolation and Vibration Control Development Department
Bridgestone Corporation, 1 Kashio-cho, Totsuka-ku, Yokohama, Japan

Technologies of seismic isolation bearings have made significant progress in these decades through the experiences in several major earthquakes such as 2011 Great East Japan earthquake. In this presentation, several new evaluation methods developed for the behavior of seismic isolators under long-period and long duration earthquake, which is one of highlighted topics in recent earthquake engineering in Japan, are introduced. Firstly, a development of new FEA approach to evaluate property-change of high-damping rubber isolator subjected to long duration earthquake. The heat and fatigue generated inside high-damping rubber during repeated loading causes the degradation of the physical properties, such as stiffness or damping ratio. In the newly developed FEA methods, degradation factors for those phenomena were identified by repeated-cyclic loading test of scaled-model of the isolators. The results showed good agreement with test results and the applicability to further study on this problem was indicated. The other topic is, “On-line testing” of seismic isolation bearing consisting of computer and dynamic testing machine. The computer solves equation of motion of the seismically isolated structure expressed as numerical model, with input of reaction force of the bearing obtained from dynamic loading. This system is considered as an effective method to study the influence of complex characteristics of rubber bearing to the behavior of the structure during earthquake as well as the property change of the isolator by using actual rubber bearing under repeated loading instead of numerical analysis. Testing in series of several artificial long duration earthquakes was conducted and the results were discussed with comparison of nonlinear numerical analysis. Although some differences were observed in on-line method and numerical analysis, and a problem in the on-line system was pointed out, the applicability and efficacy of the system were verified through the tests.