Department of Civil Engineering and Engineering Mechanics
Columbia University

Current Challenges and Advances in Modern Seismic Protection Technologies: From Dynamic Similitude and Wavelet Analysis to Health Monitoring

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Time: 2:00 pm - 3:00 pm
Location: Davis Auditorium

Abstract

A widely accepted strategy for the seismic protection of important structures is the implementation of isolation bearings and/or energy dissipation devices. As the demands for sustainable engineering increases, the size of bearings and dampers has increased beyond the testing limitations of most structural engineering laboratories. Accordingly, there is a need to develop consistent scaling laws for the mechanical behavior of prototype bearings and dampers.

In this seminar the seismic response of isolated structures supported on bearings with bilinear and trilinear behavior is revisited with dimensional analysis in an effort to better understand the relative significance of the various parameters that control the mechanical behavior of isolation systems. After constructing the dimensionless products that govern the seismic response of isolated structures, the seminar introduces the concept of "*complete similarity*". Using this concept, the seminar investigates the behavior of a new generation of multi-concave spherical sliding bearings and concludes that for the case of trilinear behavior the presence of the intermediate slope is immaterial to the peak response of most isolated structures—a finding that shows the response of the trilinear oscillator exhibits a complete similarity in the difference between the coefficients of friction along the two sliding surfaces as well as in the ratio of the intermediate to the final slope. This finding implies that even when the coefficients of friction of the two sliding surfaces are different, the response of isolated structures for most practical configurations can be computed with confidence by replacing the double concave spherical bearings with single concave spherical bearings with an effective radius of curvature and an effective coefficient of friction.

The seminar proceeds by presenting results from a comprehensive experimental program on medium-size and large-size fluid dampers in an effort to extract their force output during cyclic loading by simply measuring the strain on the damper housing and the end-spacer of the damper. The stress path within the damper is first discussed and subsequently via the use of linear elasticity it is shown that the experimental data obtained with commercially available strain gauges yield a force output from the damper that is in good agreement with the readings from the load cell. This comparison is achieved via the use of position and velocity transducers, which combine good accuracy together with robust performance in a marine environment.