Period-Dependent Duration Model for Crustal Earthquakes

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The most commonly used metric for ground-motion duration is based on the normalized Arias intensity which is computed from the acceleration time series. This metric measures the duration of the short-period motion that dominates the accelerations. The duration for long-period ground motion can vary from the duration based on the Arias intensity of accelration. To characterie the period dependence of the long-period ground motion, the duration is computed in the standard method using the normalized Arias intensity but using the time series of the response of a 50%-damped SDOF in a place of the acceleration time series. The duration is computed for a range of spectral periods to produce a duration spectrum. For some ground motions, the duration is nearly constant with period, and for other ground motions, the duration is much longer for periods greater than 1 sec. An example of the period dependence of two ground motions from the 1994 Northridge earthquake is shown in Figure 1. A ground-motion model for the period-dependent duration, based on magnitude, rupture distance, and VS30. The median 5-75% duration at periods greater than 3 sec is 30% larger than the traditional acceleration-based duration. The 16th-84h percentile range of the long-period/short-period duration ratio is 0.8 to 2.0. The period-dependent duration model can be used to develop target ranges on the duration of design time histories used in dynamic analyses of structures. The period-dependence of the ground motion can also be used to define the ground-motion duration for use in Random Vibration Theory (RVT) to convert Fourier spectra to response spectra. Using the period-dependent duration in RVT avoids the common practice of artifically increasing the oscilator duration at long periods.

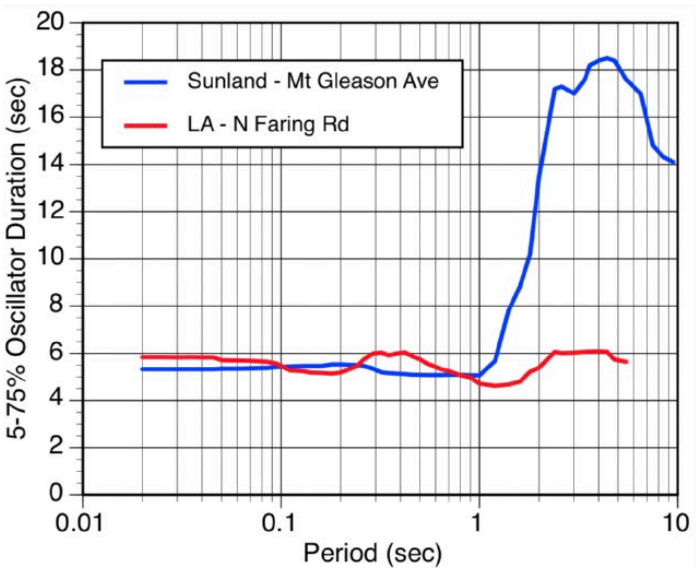

Figure 1. Period-dependent duration for two recordings from the 1994 Northridge earthquake.