Power-spectral-density analysis

**Power-spectral-density (PSD) analysis** is a type of frequency-domain analysis in which a structure is subjected to a probabilistic spectrum of harmonic loading to obtain probabilistic distributions for dynamic response measures. A root-mean-square (RMS) formulation translates the PSD curve for each response quantity into a single, most likely value. Because PSD curves represent the continuous probability density function of each response measure, most of the integrated area will occur near the resonant frequencies of the structure. For accuracy, it is important to capture response at frequency steps near the natural modes of the structure.

Harmonic loading, characterized by sine and cosine functions, may have various components at different phase angles. Either hysteretic or viscous damping may be specified, though hysteretic (displacement-based) is most common for frequency-domain applications. The frequency-dependent behaviors assigned to links and supports are applied during PSD analysis. More on harmonic loading, hysteretic damping, and an example may be found in the *CSI A
analysis Reference Manual* (Frequency-Domain Analyses, page 419).

**Steady-state analysis** is another type of frequency-domain analysis in which a structure is subjected to a given set of one or more harmonic load patterns. Response is then calculated in a deterministic manner for each frequency of vibration.

**Articles**

Additional notes on PSD include:

- Fatigue analysis is one application for which PSD analysis is useful.
- Use a constant function to ensure that the magnitude of probable load is the same at all frequencies.
- The shape of the power-spectral-density input function is dependent upon the probability of loading for each frequency, and the variation in likely load magnitude as a function of its frequency.

**See Also**

- [Tutorial by Tom Irvine](#), July 28, 2000 (PDF) - obtain the PSD function from random vibration time-history data using a bandpass filtering method