

CIVL-558 Homework Assignment #3

- 3.1) A building has been determined to have a damped natural frequency of 1.0 Hz and damping of 5.0% of critical. The structure responds with free vibrations to the initial conditions shown below. Plot approximately the first three cycles of the structure's displacement response, $y(t)$.

$$y_0 = 1.0 \text{ in.}$$
$$\dot{y}_0 = 5.0 \text{ in/sec}$$

- 3.2) A building may be assumed to have damping proportional to velocity. In a human vibration test the building is observed to complete two oscillations each second and in five oscillations its response amplitude diminishes by 50%. Calculate the damping ratio. In what proportion would the period of vibration be decreased if the damping could be removed?
- 3.3) Using damping ratios of 0% and 5%, re-plot on tripartite paper the corresponding relative displacement response spectra for the 1940 El Centro Earthquake given. (Both tripartite and response spectra on web.) Use the tripartite plot to estimate the peak relative displacement, relative velocity and absolute acceleration for a building having a fundamental frequency of 0.8 Hz and damping of 5%, when subjected to the earthquake represented by the spectra.
- 3.4) A plot of a short time-history of ground acceleration recorded from the 1940 El Centro Earthquake, (on web). The base of a linear SDOF oscillator with a natural frequency of 2Hz and zero damping is subjected to this ground motion. Use piecewise-constant recurrence formulas with a time step of 0.05-seconds to find the following: a.) Predict the relative displacement response of this oscillator at $t=0.05$ -seconds. (Assume the oscillator is initially at rest.) b.) Use the results from (a.) to obtain the relative displacement at $t=0.10$ -seconds.