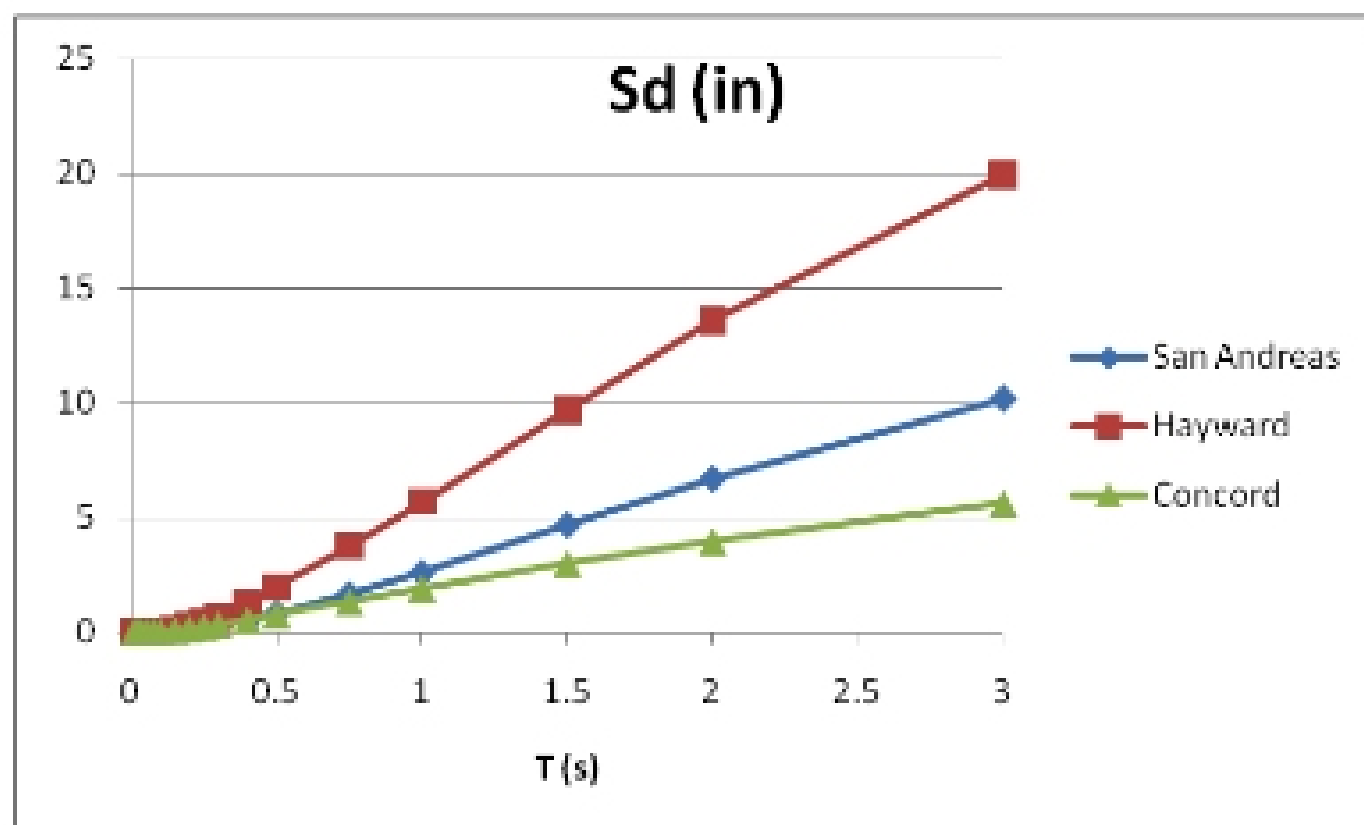
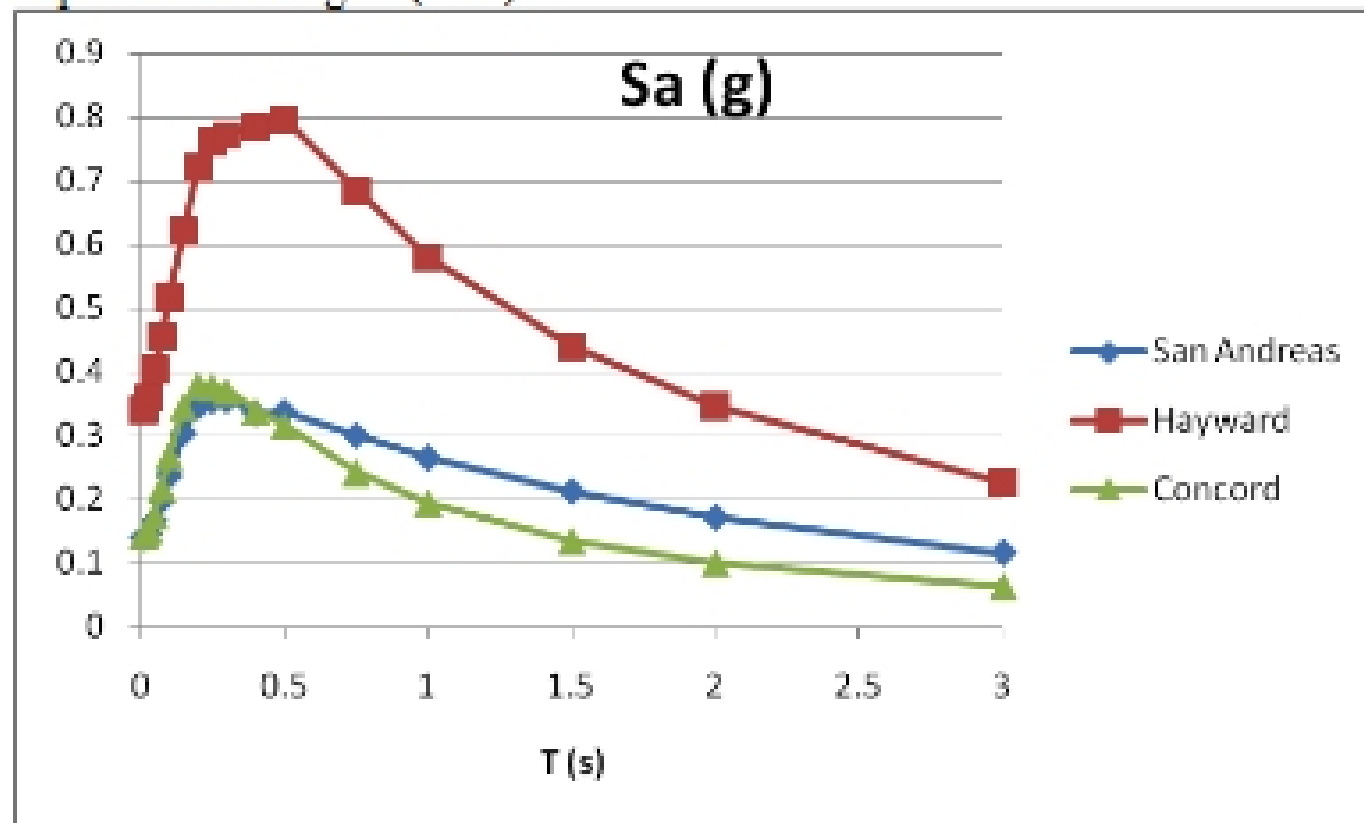


Problem 8 – Deterministic Estimation of Response Spectra

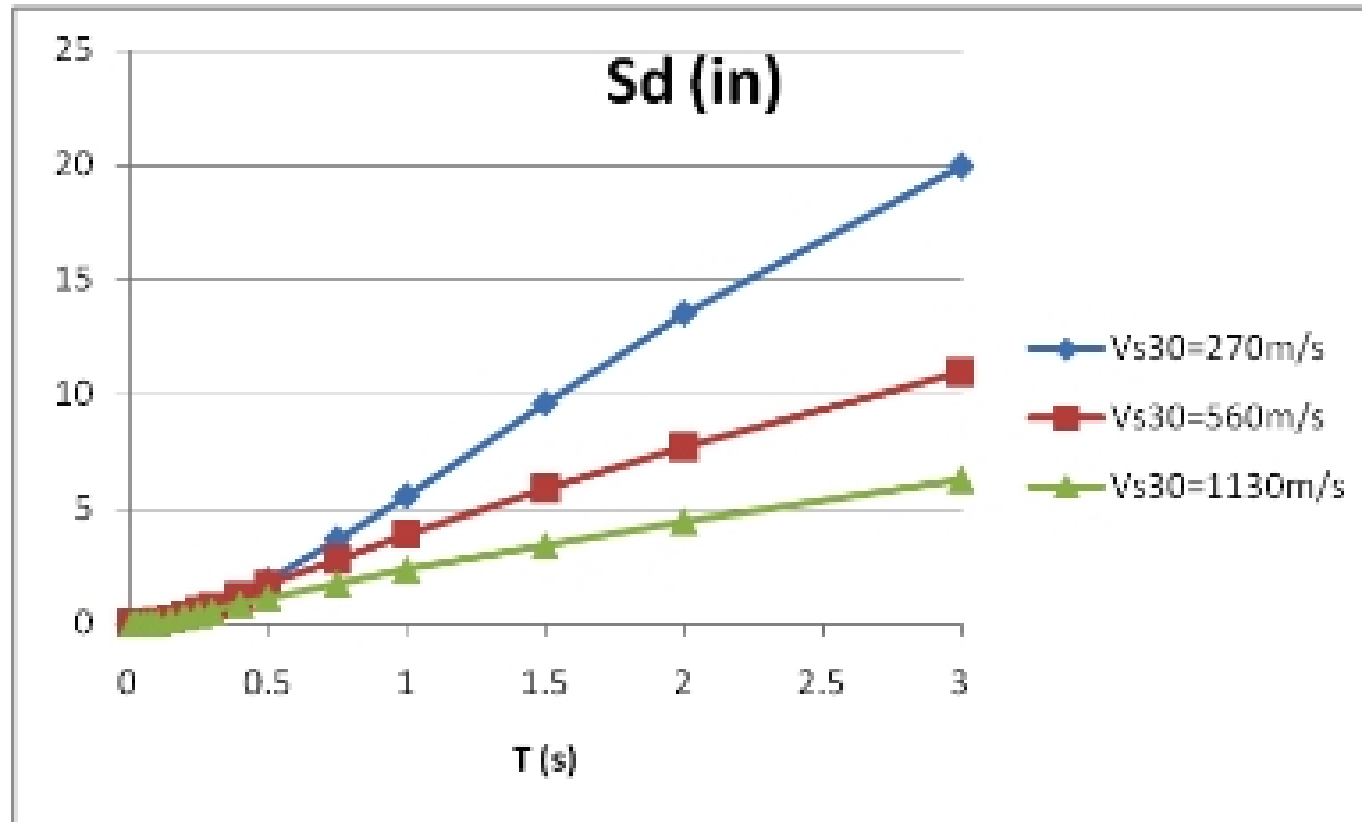
- a) See plots below for acceleration and displacement response spectra for the three faults being considered from our site (San Andreas, North Hayward, and Concord.) These spectra were generated using Campbell and Bozorgnia (2008).



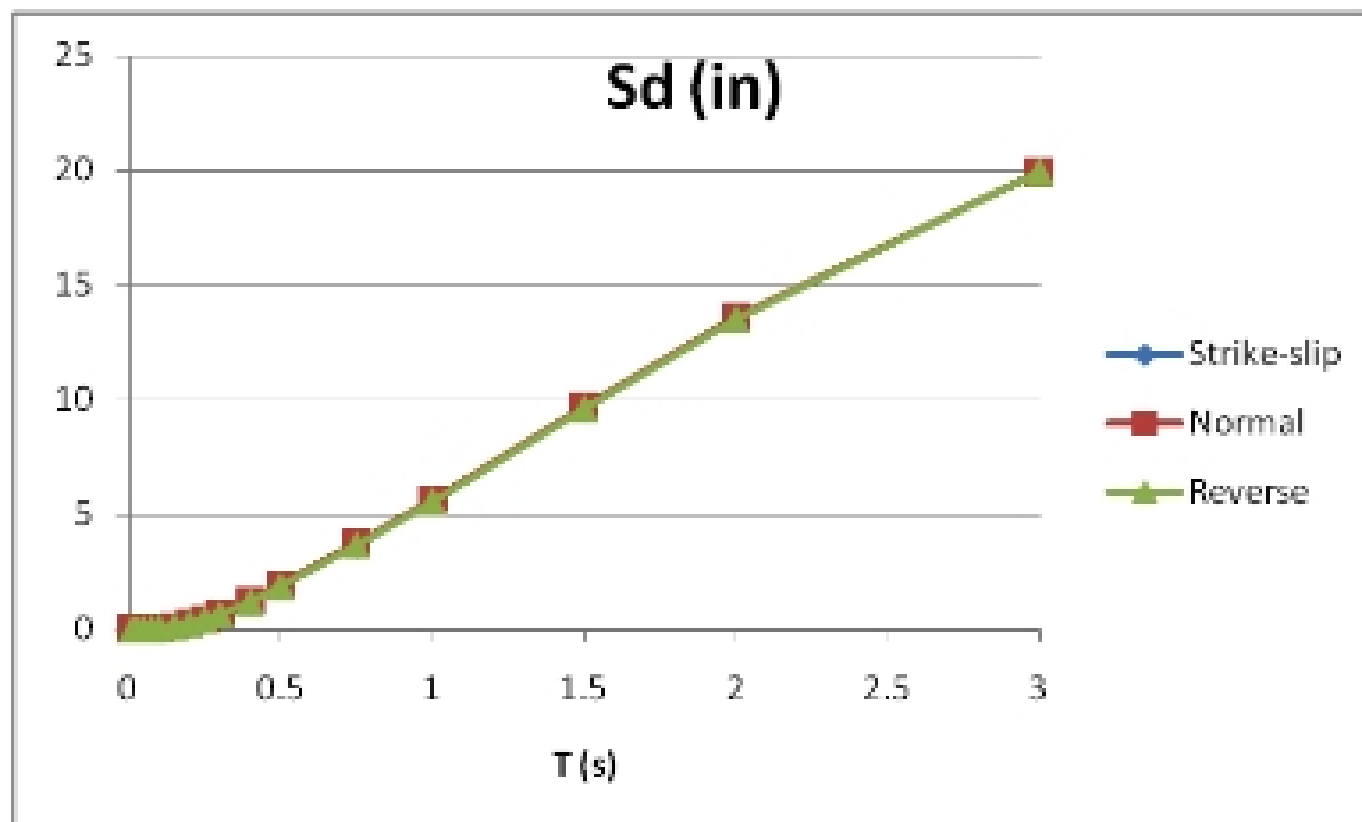
- b) The Hayward event produces higher spectral accelerations than both the San Andreas and Concord events. This is due to the close proximity of this fault to our building site. The shapes are similar, however, the following differences are observed:
- The fundamental period (period where the peak spectral acceleration occurs) increases with magnitude of shaking. Therefore, the fundamental period of the Hayward event ($T=0.5$ sec) is much higher than the Concord and San Andreas events ($T=0.2$ and 0.3 , respectively).
 - The fundamental period increases the closer you are to the seismic source. Near-fault events of the same magnitude as far-fault events will have a longer fundamental period.

- Far field events produce long-period content due to attenuation of high-frequency waves with distance. Therefore, the spectral acceleration values at long periods for the San Andreas event are higher than those of the Concord fault.

c) Let's look at the Hayward Fault (again):



Sd based on soil type (lower Vs30 corresponds to soft soil). These are the nominal Vs30 values for soil types B (1130m/s), C (560m/s) and D (270 m/s). As you can see below, soft soil can amplify displacements significantly, especially for long period structures. Remember, soft soil lengthens the predominate period of the ground motion, extending the acceleration and velocity sensitive regions of the spectra.



There is essentially no difference in spectral displacement due to variation in fault type. As we noted before, fault type has very little influence on ground motion. This isn't particularly intuitive, since different kind of faults seem very different. It's good to keep in mind when matching time histories to a uniform hazard spectrum: finding earthquake records with the right fault type doesn't tend to be as important as finding those with similar PGA, predominate period, etc.

- d) The spectral values for the 3 faults (from Campbell and Borzorgnia 2008) at $T=1s$ are presented below:

Fault	San Andreas	Hayward	Concord
$S_a(T=1s)$ (g)	0.26	0.58	0.19
$S_d(T=1s)$ (in)	2.59	5.67	1.90

As expected, the Hayward fault clearly dominates both acceleration and displacement demands.