NTUA – SCHOOL OF CIVIL ENGINEERING **23/3/2012**

CB22. ENGINEERING SEISMOLOGY

EXERCISE No 4

Use the Boore-Atkinson acceleration response spectrum for a 6.3 moment magnitude earthquake, on a normal fault, at a Joyner-Boore distance of 1 km and a soil deposit with V_{S30} = 360 m/sec in order to:

- Evaluate a corresponding artificial accelerogram.
- Combine the evaluated accelerogram with an appropriate directivity pulse in order to create an artificial near field record.
- Calculate and plot the ratio between the 5% damping acceleration spectra of the pulse like and the original artificial records to show the bell shaped amplification curve.
- For ductility values μ=2, 4 and 6 and 5% viscous damping calculate and plot the ratio between the maximum inelastic and the corresponding elastic displacements for different periods up to $2T_p$ for the fault normal component.

PULSE FUNCTION:

$$\bar{a}(\bar{t}) = \frac{a(t)}{Af_P} = \begin{cases} -\dfrac{\pi}{\gamma}\left[\sin\left(\dfrac{\bar{t}}{\gamma}\right)\cos(\bar{t}+\nu) + \gamma\sin(\bar{t}+\nu)\left(1+\cos\left(\dfrac{\bar{t}}{\gamma}\right)\right)\right], & -\pi\gamma \le \bar{t} \le \pi\gamma \text{ with } \gamma > 1 \\ 0, \quad \text{otherwise} & \end{cases},$$

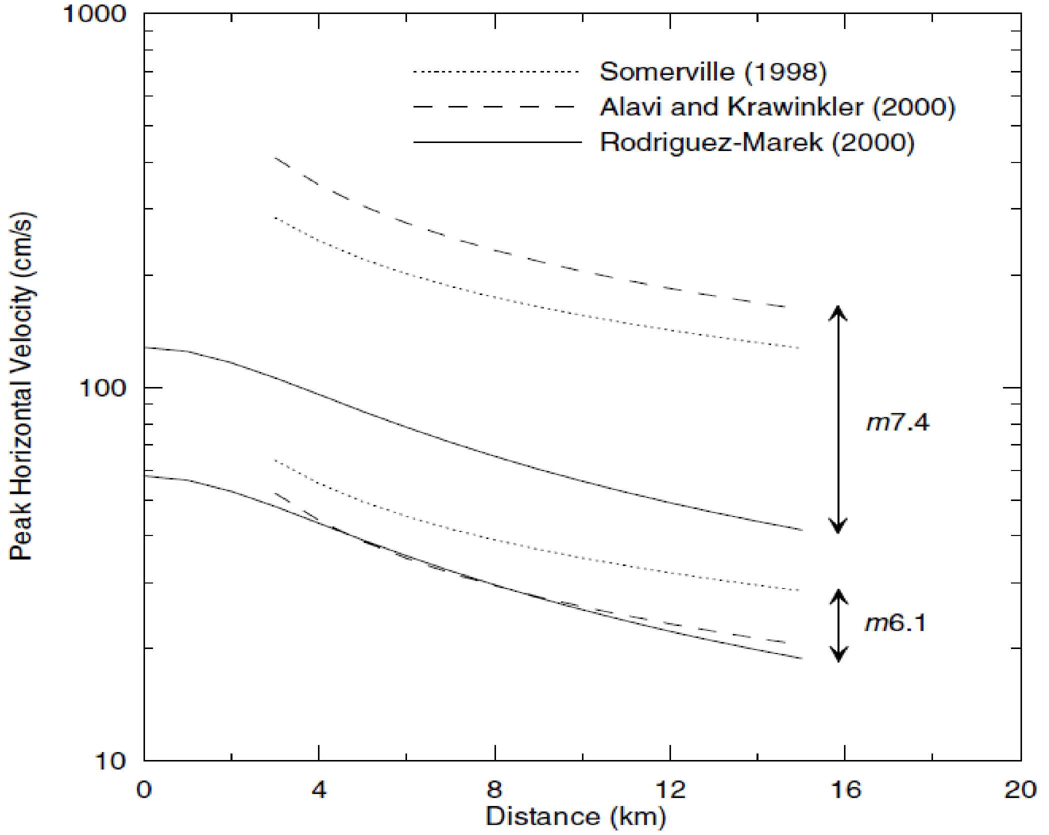
$$\bar{v}(\bar{t}) = \frac{v(\bar{t})}{A} = \begin{cases} \dfrac{1}{2}\left[1+\cos\left(\dfrac{\bar{t}}{\gamma}\right)\right]\cos(\bar{t}+\nu), & -\pi\gamma \le \bar{t} \le \pi\gamma \text{ with } \gamma > 1 \\ 0, \quad \text{otherwise} & \end{cases},$$

$$\bar{d}(\bar{t}) = \frac{d(t)}{(A/f_P)} = \begin{cases} \dfrac{1}{4\pi}\left[\sin(\bar{t}+\nu) + \dfrac{1}{2}\dfrac{\gamma}{\gamma-1}\sin\left(\dfrac{\gamma-1}{\gamma}\bar{t}+\nu\right) + \dfrac{1}{2}\dfrac{\gamma}{\gamma+1}\sin\left(\dfrac{\gamma+1}{\gamma}\bar{t}+\nu\right)\right], & -\pi\gamma \le \bar{t} \le \pi\gamma \\ \dfrac{1}{4\pi}\dfrac{1}{(1-\gamma^2)}\sin(\nu-\pi\gamma), \quad \bar{t} < -\pi\gamma & \gamma > 1 \\ \dfrac{1}{4\pi}\dfrac{1}{(1-\gamma^2)}\sin(\nu+\pi\gamma), \quad \bar{t} > \pi\gamma & \end{cases}.$$

Period-magnitude relationship

$$\log\ T_P = -2.9 + 0.5M_w$$

AMPLITUDE ATTENUATION



$$\ln(\mathrm{PHV}) = a + b\ m + c\ \ln\ (r^2 + d^2)$$

Data Set	*a*	*b*	*c*	*d*
All Motions	2.44	0.50	-0.41	3.93
Rock	1.46	0.61	-0.38	3.93
Soil	3.86	0.30	-0.42	3.93