APPENDIX A: NOTATION

a - empirical scaling coefficient in description of the fault length $L = a \times 10^{bM}$;

a_m - empirical scaling coefficient in Eqn (IV.7)

a_1, a_2, a_3, a_4 - Fourier amplitudes, $A(\omega)$ at f = 100, 80, 60 and 40 Hz (see Figure VI.2)

$a_{\max}$ - absolute peak ground acceleration

A_0 - coefficient, mainly used to describe high frequency Fourier spectrum amplitudes

$\mathcal{A}_0(T)$ - parabola w.r.t. $\log_{10} T$ which defines the frequency dependent attenuation in $\Delta^{\mathcal{A}_0(T)}$ (see Eqn (II.2))

$$\mathcal{A}_0(T) = \begin{cases} -0.732 & T \geq 1.8 \text{ sec} \\ a + b\log_{10} T + C(\log_{10} T)^2 & T < 1.8 \; sec \end{cases}$$

where $a = -0.767$, $b = 0.271$ and $c = -0.526$, (see Trifunac and Lee, 1990).

$\mathcal{A}tt(\Delta, M, T)$ - a function describing the frequency ($f = 1/T$) dependent attenuation of the spectral amplitudes versus distance Δ and magnitude M (as defined by Eqn II.2)

A - fault area, $A = WL$ (km^2);

$A(\omega)$ - Fourier amplitude spectrum of ground acceleration

b_0, b_1, b_2 - coefficients in Eqn (V.7)

b - empirical scaling coefficient in $L = a \times 10^{bM}$;

b_m - empirical scaling coefficient in Eqn (IV.7)

$b_i(T)$ - empirical scaling "coefficient" in Eqn (II.1);

$b_i^{(j)}(T)$ - empirical scaling coefficients in Eqn (II.1) for the indicator variable j;

c - empirical scaling coefficient in $W = c \times 10^{bM}$

C_0 - scaling "coefficient" relating the average fault dislocation, $\overline{u}$, with the source dimension r and the rigidity of the surrounding rocks, μ;

C_0^* - proposed "average" trend of C_0 versus M (see Table IV.2, and Eqn (IV.5));

$d_0(t)$ - ground displacement pulse ($= te^{-\alpha t}$)

d - empirical scaling coefficient in $W = c \times 10^{bM}$;

$d_N(t)$ - near-field strong motion displacement (for $\Delta < S$);

$d_{N,\max}$ - static displacement after the earthquake

$d_F(t)$ - far-field strong motion displacement (for $\Delta >> S$);

$d_{F,\max}$ - peak of far-field strong motion displacement pulse

e = base of natural logarithm $e = 2.71828$

E_s - seismic energy;

$E(\omega)$ - energy spectrum amplitudes of a random function

$E[\cdot]$ - expected value

f_1 - corner frequency, $f_1 = \left(\frac{L}{v} + T_0\right)^{-1}$ (Hz);

f_2 - corner frequency, $f_2 = 2.2/W$ (Hz);

f_{co} - frequency ($= 1/T(N_c)$) below which Eqn (II.1) is not valid (see Table II.3)

$G4RM$ - short for "group of four regression models". Model 4 is shown in Eqn (II.1) (1. MAG-SITE; 2. MAG-DEPTH; 3. MAG-SITE-SOIL; 4. MAG-DEPTH-SOIL);

h - depth (thickness) of the sedimentary layer beneath the station (km);

h_0 - depth (below the surface) of the top edge of a vertical fault plane (km);

H - focal depth (km);

H_L - thickness of equivalent horizontal layer used in computation of local site amplification by wave interference

$H(\omega)$ - transfer function of a linear system

$KS(T)$ - "coefficient" for a fixed T, in the Kolmogorov-Smirnov test of significance (see Tables II.1 and II.2);

L, $L_{\min}$ - fault length and minimum fault length (km);

M - magnitude;

$M_{\min}$, $M_{\max}$ - minimum and maximum magnitudes defining the range $M_{\min} < M < M_{\max}$ where the strong motion amplitudes begin to saturate. For $M > M_{\max}$, $PSV(T)$ in Eqn (II.1) is constant, i.e. does not grow with M;

M_0 - seismic moment ($= \mu \overline{u} A$) (dyne cm);

M_L - the local magnitude scale (Richter, 1958);

M_L^{SM} - local magnitude computed from strong motion accelerograms;

M_p - "magnitude" as published in various catalogues (without specification of the wave type used, or the procedure employed);

M_s - surface wave magnitude;

m_n - moments of $E(\omega)$ (energy spectrum) about $\omega = 0$;

N - number of peaks in a random function;

N_c - index in $T(N_c)$ such that Eqn (II.1) is valid for $T < T(N_c)$. Coefficients $b_i(T)$ and $b_i^{(j)}(T)$ are given at $N = 1, ..., 12$ discrete periods equal to .04, .065,... 7.5 and 14.0. See Tables II.1 and II.2;

$p(\varepsilon, T)$ - probability density function describing the distribution of $\varepsilon(T)$ in Eqn (II.7);

$PSV(T)$ - Pseudo relative velocity spectrum at period of oscillator T.;

Q - the quality factor;

r - the characteristic source dimension (see Table IV.2) (km);

$r(t)$ - "response" function;

$\bar{r}$ - root mean square amplitude of the peaks of $r(t)$;

r_{rms} - root mean square value of the function $r(t)$;

$r_{\max}$ - peak response of a random function;

R - epicentral distance (km);

$R(\omega)$ - Fourier amplitude spectrum of response $r(t)$;

R_0 - transition distance where the frequency dependent attenuation $\mathcal{A}tt(\Delta, M, T)$ becomes $\sim -R/200$ as in $\log_{10} A_0(R)$ (Richter, 1958);

s - the geologic site condition parameter ($s = 0$ for sediments, $s = 2$ for basement rock and $s = 1$ for intermediate sites, see Trifunac and Brady, 1975);

s_L - a parameter describing the local soil site condition ($s_L = 0$ for "rock" sites and $s_L = 2$ for deep soil sites);

S - the source dimension used in Eqn (II.3) and defined by Eqn (IV.3). Also used in Eqn (V.29); the "source dimension" $S = .01 \times 10^{.5M}$(km);

$S^{(1)}$, $S^{(2)}$ - indicator variables describing the local geologic conditions

$$S^{(1)} = \begin{cases} 1 & \text{if } s = 1 \\ 0 & \text{otherwise} \end{cases} \qquad S^{(2)} = \begin{cases} 1 & \text{if } s = 2 \\ 0 & \text{otherwise} \end{cases}$$

$S_L^{(1)}$, $S_L^{(2)}$ - indicator variables describing the local soil conditions

$$S_L^{(1)} = \begin{cases} 1 & \text{if } s_L = 1 \\ 0 & \text{otherwise} \end{cases} \qquad S_L^{(2)} = \begin{cases} 1 & \text{if } s_L = 2 \\ 0 & \text{otherwise} \end{cases}$$

S_0 - the coherence radius (Gusev, 1983) of the source (km);

S_1 - distance between the station and the top of a vertical fault (km); see Eqn (V. 29);

$SD(T)$ - relative displacement response spectrum at period T;

t - time (sec);

$t_{\max}$ - time of maximum relative response $x_r(t)$; T - period of vibration, $T = 1/f$ (sec);

$T(N)$ - periods (N = 1,2,...,12) for which $b_i(T)$, $M_{\min}$, $M_{\max}$, $\mu(T)$ and $\sigma(T)$ are prescribed in Tables II.1 and II.2, Eqn (II.1) can be used for $N < N_c$ (see Tables II.1 and II.2) i.e. for $T < T(N_c)$;

T_c - cut off period $T_c = T(N_c) = 1/f_{co}$ (see Table II.3);

$\overline{u}$ - dislocation averaged over the fault surface;

v - an indicator variable; v = 0 for horizontal motion, v = 1 for vertical motion;

v - dislocation velocity (km/sec);

W, $W_{\min}$ - fault width, minimum fault width;

x_r - relative displacement of single-degree of freedom system;

$\left|{}_N X_r(T,\varsigma)\right|_{\max}$ and $\left|{}_F X_r(T,\varsigma)\right|_{\max}$ - relative displacement spectral amplitudes for near-field and far field unit displacements, as functions of T and ς;

α - corner frequency in the Brune's spectrum (see Eqn (V.17)); also a scaling "parameter" $\alpha(T)$ describing the distribution function $p(\varepsilon, T)$ in Eqn ((II.7)). See Tables II.2 and II.3;

β - velocity of shear waves, $\beta = (\mu/\rho)^{1/2}$ (km/sec); also a scaling "parameter" $\beta(T)$ describing the distribution function $p(\varepsilon, T)$ in Eqn (II.7);

Δ - the "representative" source to station distance (see Eqn (II.3));

Δ_0 - transition distance, see Eqn (II.4);

ε - width of energy spectrum $E(\omega)$, see Eqn (VI.4);

$\varepsilon(T)$ - residuals, $\varepsilon(T) = \log_{10} PSV(T) - \log_{10} \widehat{PSV}(T)$ (see Eqn (II.6));

η - the efficiency in the expression for the apparent stress, $\eta\overline{\sigma}$;

μ - shear modulus, $\mu = \rho\beta^2$ (dyne/cm^2);

π - constant (=3.14159);

ρ - material density (gr/cm^3);

$\rho_{i,j}$ - ratio of expected peak responses at frequencies f_i and f_j;

σ - effective stress (also used as stress drop, Brune (1970), defined as the difference of stress before the earthquake and the frictional stress during faulting;

τ - the characteristic source time, $\tau = 1/f_1 = \frac{L}{2.2} + \frac{W}{6}$; the same symbol is also used as characteristic time in high frequency attenuation, $\tau \equiv \Delta/(Q\beta)$;

χ^2 - chi - squared parameter in Fisher's test of significance, See Tables II.1 and II.2;

ω - circular frequency, $\omega = 2\pi f$ (rad/sec);

ω_i = natural frequencies of single-degree-of-freedom oscillators used in mean band approximation of response for excitation frequencies $f > 25$ Hz (see Figure VI.2).

$\Omega_{NF}(\omega)$, $\Omega_{FF}(\omega)$ - near-field and far-field Fourier amplitude spectra of strong motion displacement.