VI SUMMARY AND CONCLUSIONS

The following are the main conclusions of this work:

1. This report is believed to be the first contribution on describing ***path dependent*** attenuation equations of peaks of strong ground motion. Since one of its aims has been to serve as a preamble to development of frequency dependent attenuation equations of strong motion spectral amplitudes, we conclude this report by reviewing the coefficients b_0 for different path types and for the acceleration, velocity and displacement peaks. The relevant values of b_0 are summarized in Table VI.1 and the applicable path types are shown in Figure II.10. It is seen that for all peaks, the largest negative value of b_0 is for path type 1 (both source and station are in the same sedimentary basin; $r = 0$). The smallest negative value of b_0 is found for paths 4, 5 and 8 (the waves propagate essentially through basement rock). These trends are as one would expect them to be, since the attenuation of higher frequency waves through sediments is expected to be stronger.

2. Peak amplitudes, as modeled by our equations in this report, attenuate with distance as in

$$\log_{10} \left\{ \begin{array}{c} a_{\max} \\ v_{\max} \\ d_{\max} \end{array} \right\} = \cdots + b_0 \log_{10}(\Delta/L) + \cdots + (b_{70} r + b_{71}(1-r))R/100. \qquad (VI.1)$$

The fist term describes the average overall attenuation, while the terms involving b_{70} and b_{71} describe the "correction" accounting for the proportion of the wave path through rock (r) or sediments ($1-r$). As Table VI.1 shows, b_0 is smallest for all peaks (acceleration, velocity, displacement) for the path type 1 (see Fig. II.10). Furthermore b_{71} is smallest for peak accelerations (high frequencies), and largest (positive) for peak displacements. At high frequencies (short wave lengths) this correction term appear to reflect low Q. For peak displacements (long periods) the attenuation appears to be overpowered by prolonged motion (leading to larger peaks), caused by reflections from the edges and the boundaries of the basins (Novikova and Trifunac 1994, 1995).

The above "correction" terms b_{70} and b_{71} can be applied only for R less than about 100 km, where the data is now available, and where most of our equations apply. Beyond $\sim$ 100 km the predominant wave types change, become dominated by surface waves and so the terms b_{70} and b_{71} do not apply beyond this distance range. In the equations presented in this report we assume that these corrective terms apply for $R \leq R_{\max}$ and then remain unchanged for $R > R_{\max}$. This limitation results from inadequate number of strong motion data for distances greater than 50 to 75 km. With current trends of recording and processing the strong motion data, this limitation is likely to stay with us for long time.

Table VI.1

Review of scaling coefficients b_0, b_{70} and b_{71} in

$$\log_{10}\left\{\begin{array}{c} a_{\max} \\ v_{\max} \\ d_{\max} \end{array}\right\} = \cdots + b_0 \log(\Delta/L) + \cdots + [b_{70} r + b_{71}(1-r)]R/100$$

for peaks of strong motion acceleration, velocity and displacement, and for different path types.

	acceleration			velocity			displacement		
Pat Type	b_0	b_{70}	b_{71}	b_0	b_{70}	b_{71}	b_0	b_{70}	71
All	-1.38	-0.28	-0.24	-1.19	-0.23	-0.16	-2.23	-0.37	-0.24
1	-1.60	0.	-0.36	-1.47	0.	-0.06	-2.83	0.	0.54
2 & 6	-1.38	-0.43	-0.19	-1.24	-0.26	0.003	-2.47	-0.32	0.04
3 & 7	-1.46	-0.26	-0.34	-1.40	-0.32	-0.29	-2.41	-0.49	-0.39
4, 5 & 8	-1.17	-0.33	-0.07	-1.03	-0.36	0.071	-2.11	-0.62	0.008
4, 5 & 8(100%)	-1.16	-0.24	0.	-1.01	-0.21	0.	-2.07	-0.41	0.

3. Large number of records in the present data base (~ 2000), and so far the largest subset of data with known local soil and local geological site condition parameters, have allowed us, for the first time, to initiate tests on the relative contribution and significance of the common scaling parameters. We found that the average shear wave velocity in the top 30 m below ground surface does not appear to be a significant factor in determining the peak amplitudes. With few exceptions, we found that the local soil effects on recorded peak amplitudes can be described well by the local soil parameter s_L. Other studies which consider the average shear wave velocity, v_L, only, appear to find that it is a significant scaling parameter. This is because v_L is highly correlated with s_L and s (or h). We conclude that s_L and s (or h) are the two (three) significant variables from among those we can possibly use at present, and that v_L can be neglected for most empirical estimates of peak amplitudes of strong ground motion. We find consistent trends and reach similar conclusion in our current studies on the duration of strong ground motion (Novikova and Trifuanc, 1995).