ON THE RESPONSE CALCULATION IN THE TIME DOMAIN OF THE GROUND CONSIDERED THE VISCOSITY AND THE ENERGY DISSIPATION TO THE BEDROCK LAYER

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DISCUSSION BY

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A very good way of representing energy loss due to internal viscous damping would be a lumped mass model, although effect of base radiation could be brought in by adopting an equivalent damping factor for low base impedence ratio. (Impedence ratio = ρtrans x S trans/ ρinci x S inci where ρ = density, S = wave propagation vel).

An ideal way of representing the energy loss by radiation is by a wave motion system. When the layers behave elastically or when base impedence ratio is high, radiation becomes the main source of energy dissipation.

Indeed combining the two should produce reliable parameters for the lumped mass system. With regard to the given example, I do not think a good system was adopted for choosing the number of masses in the lumped mass system. An accurate value for the period T would be obtained if the number of chosen masses "Z_m" for each layer and the total system was given by:

$$Z_m \geq \frac{5h_m}{TS_m} + 5\left[\frac{h_m}{TS_m}\right]^{\frac{1}{2}} \quad \ldots \quad \ldots \text{(Roesset's formula)}$$

where h_m = thickness of each layer, S_m = shear wave vel, T = calculated period, for the total system S_m = S average; h_m = h_{total}.

The above formula was modified in the following form:

$$Z_m \geqslant \frac{5h_m}{h_{total}} \quad x \quad \left[\frac{h_{total}}{TS_m}\right]^{\frac{1}{2}} \left[1 + \left[\frac{h_{total}}{TS_m}\right]^{\frac{1}{2}}\right] \quad \text{...(modified formula)}$$

Table 1 summarises the results calculated using the above formulae for the given example. The number of masses chosen in layers 2, 5 and 6 were low and in layer 7 high (safe) by the Roesset's formula. The number of masses chosen in layers 1, 7 and 8 were high compared to the modified formula. The total number of masses chosen to represent the total layer was well above the number calculated by the formulae, which produced the same results.

There is no doubt that curve of Amplification factor vs. Frequency (Fig. 2) is invaluable; amplification curve does not depend on any special earthquake, it is dependent only on the nature and property of the soil. It also shows in what values of input frequencies material and radiation damping would be operative, although this information alone will not be enough for real design purposes.

TABLE 1
THE VALUES OF CHOSEN
AND CALCULATED MASSES

layer No.	S_m	calculated (Roesset) Z_m	employed Z_m	calculated (modified) Z_m
1	51.04	1.99	2 h	0.93
2	38.32	2.00	L 1	0.88
3	57.43	0.97	1	0.28
4	57.43	0.37	1	0.05
5	73.55	2.11	L 2	1.10
6	44.67	2.28	L 2	1.12
7	118.25	2.24	h 5 h	1.50
8	63.81	3.74	5 h	2.63
9	191.66	-	-	-