Reference

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VERTICAL OSCILLATION OF EARTH AND ROCKFILL DAMS: ANALYSIS AND FIELD OBSERVATION*

Discussion by TATSUO OHMACHI**

In formulating the equation of motion followed by the solution, the author employes a simplified stress-strain relationship expressed as

$$\sigma_z=\frac{E(z)}{1-\nu^2}\varepsilon_z\equiv\frac{G(z)}{\eta}\varepsilon_z \qquad (4b)'$$

where

$$\eta=\frac{1-\nu}{2} \qquad (4c)$$

As is written in the footnote, this relationship can be derived by assuming

$$\varepsilon_x=0 \text{ and } \sigma_y=0 \qquad (23)$$

Under these assumptions, the equation of motion in the vertical direction can be reduced to an uncoupled form expressed as

$$\rho\ddot{v}=\frac{1}{z}\frac{\partial}{\partial z}\left[\frac{G(z)}{\eta}z\frac{\partial v}{\partial z}\right]+G(z)\frac{\partial^2 v}{\partial x^2} \qquad (3)'$$

The uncoupled equation of motion, however, can be derived by employing the following relationship which has been commonly used for longitudinal vibration of bars

$$\sigma_z=E(z)\varepsilon_z\equiv\frac{G(z)}{\eta^*}\varepsilon_z \qquad (24)$$

where

$$\eta^*=\frac{1}{2(1+\nu)} \qquad (25)$$

Since the difference between Eq. (24) and Eq. (4b)′ is only in their coefficient term, the formulation process described by the author is valid even for Eq. (24) if η is substituted by η^*. Moreover, due to small numerical difference between η and η^* over a whole range of Poisson's ratio, the difference in vibration characteristics such as natural frequencies and vibration mode shapes between the two cases will not be significant. Thus, the choice may depend on personal opinion for practical purposes.

An advantage of Eqs. (24)-(25) will be disclosed, if Eq. (3)′ is compared with the simplified equation of motion in the dam axis direction which is expressed as (Abdel-Ghaffar & Koh, 1981; Gazetas, 1981 b)

$$\rho\ddot{u}=\frac{1}{z}\frac{\partial}{\partial z}\left[G(z)z\frac{\partial u}{\partial z}\right]+E(z)\frac{\partial^2 u}{\partial x^2} \qquad (26)$$

Note that Eq. (26) can be directly derived from Eq. (3)′ by exchanging $E(z)$ and $G(z)$ if η is defined as the ratio $G(z)/E(z)$ which is the definition of η^*.

* By G. Gazetas, Vol. 21, No. 4, Dec. 1981, pp. 56-68.

** Associate Professor of Environmental Engineering, The Graduate School at Nagatsuta, Tokyo Institute of Technology, Nagatsuta-cho, Yokohama, Kanagawa.