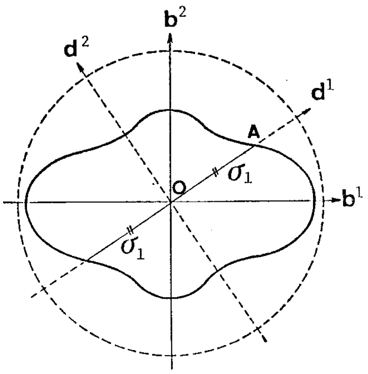

Fig. 4.

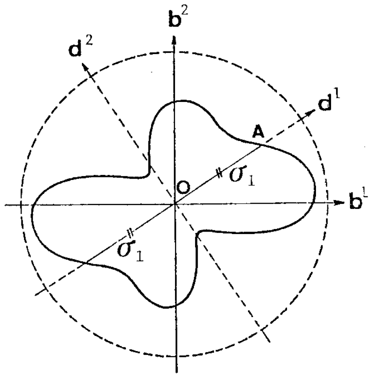

Fig. 5.

of sign of $\boldsymbol{b}^{\alpha}$, materials in Eq. (63) are at most orthotropic with the axes of symmetry $\boldsymbol{b}^{\alpha}$ (Fig. 4). If the response of the material has no symmetry except the origin such as Fig. 5, there is no particularly convenient choice of $\boldsymbol{b}^{\alpha}$. We may express such an anisotropic response by introducing $\boldsymbol{b}^1 \cdot \boldsymbol{\varepsilon} \boldsymbol{b}^2$ into f in Eq. $(63)_1$ although $\boldsymbol{b}^{\alpha}$ have then no prefered directions.

Errata

Finally, we would like to correct here some misprints and mistakes in our paper.

p. 16, in Mathematical Symbols :

$$\|\boldsymbol{A}\| = \sqrt{tr(\boldsymbol{A})^2} \longrightarrow \sqrt{tr(\boldsymbol{A}\boldsymbol{A}^T)}$$

p. 18, left line 11 and Fig. 3 :

$$\frac{\partial \boldsymbol{x}}{\partial \boldsymbol{X}} \text{ and } \frac{\partial \bar{\boldsymbol{x}}}{\partial \boldsymbol{X}} \longrightarrow \frac{\partial \boldsymbol{x}_s}{\partial \boldsymbol{X}} \text{ and } \frac{\partial \bar{\boldsymbol{x}}_s}{\partial \boldsymbol{X}}$$

p. 19, left line 16 :
Conversly ⟶ Conversely

p. 19, right line 20 : 1980 ⟶ 1981

p. 20, right last line :
in the anisotropic ⟶ in an isotropic

p. 21, left line 7 : strech ⟶ stretch

p. 21, right last line : $t=0 \longrightarrow t=t_0$

p. 22, right line 2 from the last :
$0 \leq s < t \longrightarrow 0 \leq s < t_0$

p. 26, left line 3 and line 6 :
(1980) ⟶ (1981), pp. 335 ⟶ pp. 355

PREDICTION OF EARTHQUAKE-INDUCED DEFORMATION OF EARTH DAMS*

Closure by Eiichi Taniguchi**, Robert V. Whitman*** and W. Allen Marr****

The writers thank Bouckovalas for his insightful discussion.

Bouckovalas has used a particular form of stress-strain relation to calculate the difference in strain for triaxial and plane-strain conditions. This certainly is a potentially important point, which deserves further attention. However, the state-of-the-art in the calculation of permanent strains is such that a possible 33% error is, today, small compared to other uncertainties in any analysis.

Bouckovalas also argues that adding the seismic force rightwards, then leftwards, and superimposing the results is not necessary since the cyclic stress-strain relation already includes stressing in both directions. This argument overlooks a problem in the analysis as we performed it. We use a stress-strain relation between static plus cyclic force and

* Vol. 23, No. 4, December 1983, pp. 126-132. (Previous discussion by G. Bouckovalas, Vol. 24, No. 2, pp. 120-121.)

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permanent strain. Our approach compares with that used by Andersen (1983) for cyclic wave loading of offshore structures.

In calculating permanent displacements we impose forces at the nodes for static and cyclic conditions. The nodal forces for static loading of a dam are primarily vertical. Those for cyclic loading are primarily horizontal, first in one direction, then in the opposite direction. If we apply the static nodal forces together with cyclic nodal forces in one direction (say downstream), the resulting permanent displacements are principally downward and downstream. This tends to produce permanent horizontal displacements in the upstream shell in the downstream direction. Such a result is not correct. Consequently we adopted the procedure where the cyclic nodal forces are applied first in one direction, then the opposite. The resulting patterns of permanent displacement agree with what one would expect for shaking of a dam.

We readily admit that this pragmatic approach theoretically overpredicts permanent displacements. However, unconsidered factors including rotation of principal planes and multidirectional shaking probably reduce the discrepancies.

Our approach considerably simplifies a complex theoretical, experimental and numerical problem into a procedure an engineer can reasonably apply. We look forward to results from other researchers which quantify the error introduced by our simplifications.

References

6) Andersen, K. H. (1983) : "Foundation analyses for gravity platforms," Report 51500-1, Norwegian Geotechnical Institute, Oslo, Norway.