IMPLEMENTATION OF A BUBBLE MODEL IN *FLAC* AND ITS APPLICATION IN DYNAMIC ANALYSIS

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ABSTRACT

Methodologies of implementing nonlinear constitutive models of soil in *FLAC* are studied in order to reduce numerical distortion, which has been found to occur in nonlinear dynamic analysis when a nonlinear soil model is implemented using an 'apparent modulus' approach. Analyses undertaken using several simple nonlinear soil models indicate that use of 'plastic correction' approach can eliminate or minimize the problem. This approach is therefore adopted in the thesis to implement in *FLAC* a bounding surface bubble soil model, *i.e*. the Bubble model. Satisfactory performance of the Bubble model has been obtained in dynamic analysis without using any of the additional mechanical damping given in *FLAC*.

An analytical study on the Bubble model is carried out with *FLAC*. On the basis of the study, the hardening function is modified to better incorporate size ratio effects of the yield surface and is explored to eliminate abrupt transition in stiffness from elastic region to yielding. Pore water pressure is formulated with the assumption that the pore water pressure is generated as a response to the constant volume constraint which prevents the tendency for volume change when plastic volumetric strain takes place. The formulation is added to the Bubble model so that pore water pressure can be generated automatically by the model for fully saturated and undrained soil. *FLAC* analyses indicate that the Bubble model is generally in good agreement with published experimental data.

The parameters and initial conditions associated with the Bubble model are studied with *FLAC* analyses in triaxial stress space to investigate their influence on the model and to investigate their effective ranges. Both large and small strain behaviors of the model are explored in the parametric study.

Finally, the Bubble model is applied in the modeling of vertical vibration of rigid strip foundations. The influence of soil nonlinearity on vertical compliance of rigid foundations is investigated. Some major factors are considered, which include initial stress level in soil, level of excitation and mass ratio of foundation.

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