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Modeling of dense expansive soils subjected to wetting and drying cycles based on shakedown theory

Kai Li, Hossein Nowamooz, Cyrille Chazallon and Bernard Migault

Group of Civil Engineering in Laboratory of ICUBE, INSA Strasbourg
24 Boulevard de la Victoire, 67084, Strasbourg, France
kai.li@insa-strasbourg.fr

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Expansive soils generally contain smectite clayey particles that join the other soil components to form aggregates. The microstructure, corresponding to the aggregates and the macrostructure, corresponding to arrangement of the aggregates were observed in previous studies. The volume change of these materials exposed to several wetting and drying cycles, show a reversible equilibrium state at the end of several cycles. For the dense materials, the hysteresis phenomenon is negligible, because macropores are absent in this material.

Zarka's theory, previously used to model kinematic hardening materials such as steel structures [1] subjected to cycling loading, is a direct method, since elastic and plastic shakedown can be determined only according to the extreme positions of the plasticity convex in the transformed internal parameter plane. The existed models of expansive soils (e.g. BExM) are based on step-by-step calculation method, leading to unrealistic calculation time, especially for large number of cycles.

In this context, an analytical model based on shakedown theory with a combined hardening is developed. The required parameters of the proposed model are calibrated by test results obtained for highly compacted expansive soils in oedometric tests [2]. The comparisons of the test results with the model estimations show that the proposed model is able to simulate the hydromechanical behaviour of dense expansive soils subjected to suction cycles.

REFERENCES

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