Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

A simple model for the hysteretic elastic shear modulus of unsaturated soils

Cite this as: Jie XU, Chao ZHOU, 2016. A simple model for the hysteretic elastic shear modulus of unsaturated soils. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 17(7):589-596.
http://dx.doi.org/10.1631/jzus.A1600300

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Background and objective

- The elastic shear modulus G_0 (also referred as very small strain (less than 0.001%) shear modulus) of soil is an important parameter to predict ground deformation and the serviceability of many earth structures in geo-energy and geo-environmental engineering.
- The principal objective is to develop a simple model to capture the hysteretic G_0 of unsaturated soils with fewer parameters, considering the effects of mean net stress, suction, wetting-drying and void ratio.

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Mathematical formulations

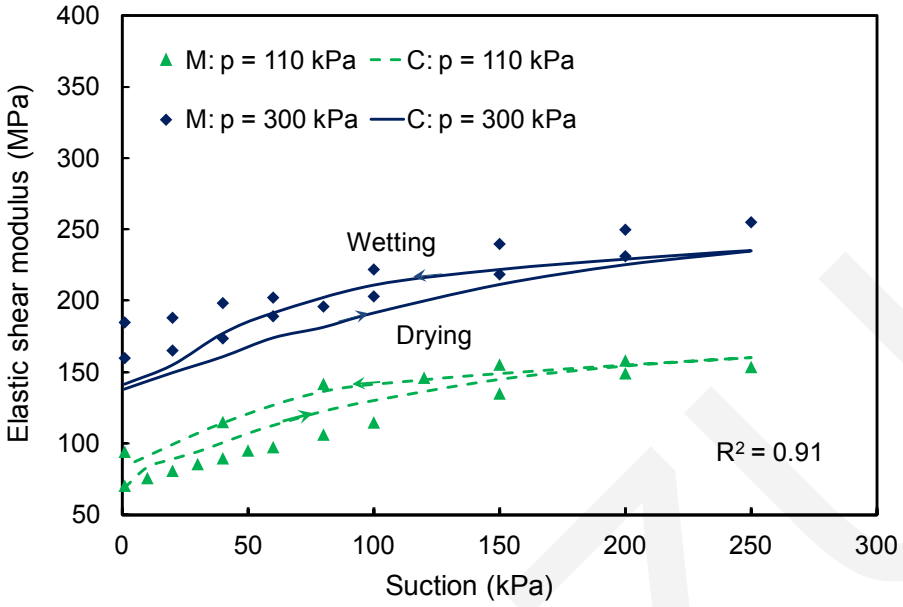
A semi-empirical equation is newly proposed for the elastic shear modulus G_0 of unsaturated soils:

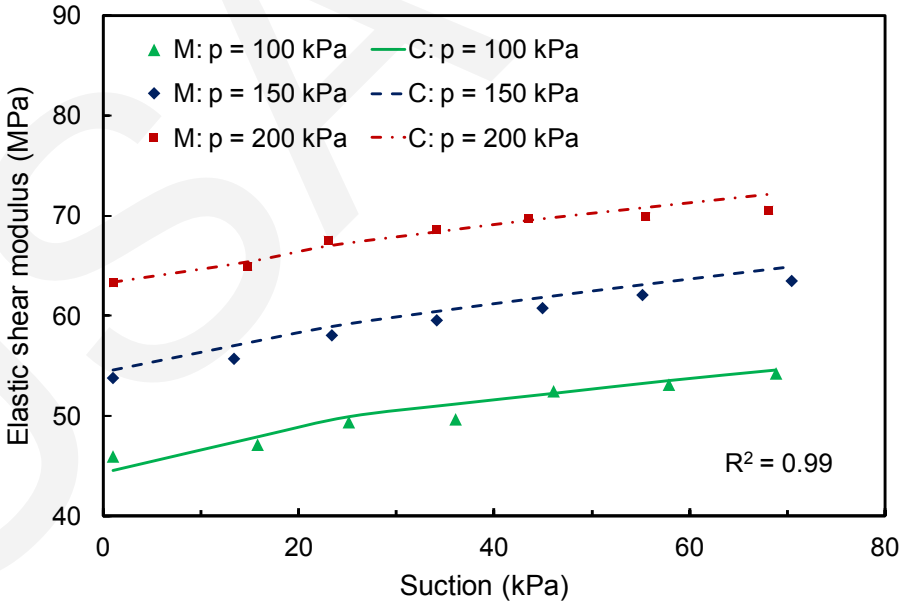
$$G_0 = C_0 (1+e)^{-3} \left[\left(\frac{p^*}{p_{\text{ref}}} \right)^{0.5} + C_s \xi^{0.5} \right]$$

The mean Bishop's stress $p^* = p + S_r s$ **and the bonding variable** $\xi = f(s)(1 - S_r)$ **are adopted for considering the average skeleton force between soil particles and the additional normal forces provided by water menisci.**

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Verification of the simple model





Comparisons between measured and calculated G_0 of compacted clayey silts tested by Ng et al. (2009) and Khosravi and McCartney (2012)

Conclusions

- **A simple semi-empirical model is newly proposed for the hysteretic elastic shear modulus G_0 of unsaturated soils, requiring only two parameters.**
- **Comparisons between measured and calculated results demonstrate that the proposed equation is able to capture the influences of various factors on G_0, including mean net stress, suction, wetting-drying and void ratio.**

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