Monotonic & Dilatory Piezocone Dissipation in NC and OC Geomaterials

The hybrid solution for porewater decay monitored by piezoprobes, driven piles, and piezocone dissipation tests is based on cavity expansion theory combined with critical state soil mechanics and a rigorous mathematics derivation. For practical use, an approximate closed-form expression is presented here. In lieu of merely matching one point on the dissipation curve (i.e, t_{50}), the entire curve is matched to provide the best overall value of c_h. The excess porewater pressures Δu_t at any time t can be compared with the initial values during penetration (Δu_i). Interestingly, the CE-MCC approach directly provides an evaluation of the soil rigidity index ($I_R = G/s_u$) as well:

$$I_R = \exp\left[\left(\frac{1.5}{M} + 2.925\right)\left(\frac{q_t - \sigma_{vo}}{q_t - u_2}\right) - 2.925\right]$$

The measured initial excess porewater pressure ($\Delta u_i = u_2 - u_o$) is given by:

$$\Delta u_i = (\Delta u_{oct})_i + (\Delta u_{shear})_i$$

where $(\Delta u_{oct})_i = (2M/3)\,\sigma_{vo}'(OCR/2)^{\Lambda}\ln(I_R)$ = the octahedral component

and $(\Delta u_{shear})_i = \sigma_{vo}'[1 - (OCR/2)^{\Lambda}]$ = the shear-induced component.

The porewater pressures at any time are obtained in terms of the modified time factor T* from:

$$\Delta u_t = (\Delta u_{oct})_i\,[1 + 50\,T^*]^{-1} + (\Delta u_{shear})_i\,[1 + 5000\,T^*]^{-1}$$

where $T^* = (c_h\,t)/(a^2\,I_R^{0.75})$.