Vertical Spring Constant (Vertical Modulus of Subgrade Reaction—k)

$k/G_s = 1.3\ (E_p/E_s)^{-1/40}\ [1 + 7\ (L/D)^{-0.6}]$ *(Mylonakis, 2001)*

G_s = soil shear modulus; E_p and E_s = pile and soil Young's modulus;
L = pile length
D = pile diameter

(Note: The above equation should be used only for vertical springs.)

Japan Code

Horizontal Subgrade Reaction Coefficient Specified in the Specifications of Highway Bridges

k_h Based on Elastic Theory

One of rational approach to obtain k_h is to estimate it based on the linear elastic solution of rigid circular plate on half infinite elastic body (e.g. Terzaghi, 1943, p. 382).

$$k_h = \frac{E}{I_p(1-\nu^2)B} \tag{1}$$

where,

- B: diameter of rigid circular plate
- E: Young's modulus of soil from rigid circular plate loading test of plate diameter B
- I_p: shape coefficient (for circular shape, $I_p = 0.79$)
- ν: Poisson's ratio of soil
- k_h: horizontal subgrade reaction coefficient for diameter B