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DEVELOPMENT OF A NEW CALCULATION METHOD FOR STRIP FOUNDATIONS ON DEPTH-DEPENDENT NON-HOMOGENEOUS HALF-SPACE

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Abstract. This paper presents a new calculation methodology for strip foundations resting on a depth-dependent non-homogeneous elastic half-space. The soil non-homogeneity is modeled by a variation of the elastic modulus with depth $E_z = E_0 \cdot (1 + \alpha \cdot \sqrt[4]{z})$, and settlement computation is based on the solution of the Boussinesq problem $w_z = P \cdot w_* \cdot \frac{1}{r} \cdot J(\tau)$. For the homogeneous case,

$$J(\tau) = 1 + 6 \cdot \tau^4 \cdot \ln\left(1 + \frac{1}{\tau}\right) - 6 \cdot \tau^3 + 3 \cdot \tau^2 - 2 \cdot \tau - 6 \cdot \tau^{12} \cdot \ln\left(1 + \frac{1}{\tau}\right) + 6 \cdot \tau^{11} -$$

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$$-3\cdot\tau^{10}+2\cdot\tau^{9}-\frac{3}{2}\cdot\tau^{8}+\frac{6}{5}\cdot\tau^{7}-\tau^{6}+\frac{6}{7}\cdot\tau^{5}-\frac{3}{4}\cdot\tau^{4}+\frac{2}{3}\cdot\tau^{3}-\frac{3}{5}\cdot\tau^{2}+\frac{6}{11}\cdot\tau$$

$$w_*=\frac{1-\mu_0^2}{\pi\cdot E_0},\tau=\frac{12\alpha}{13}\cdot\sqrt[4]{r}.$$

Analytical equations are derived, while for non-homogeneous conditions, numerical integration using the five-point Gauss method is applied. The influence of soil non-homogeneity and foundation flexibility on the stress-strain state is examined through computational examples. Results show that increasing non-homogeneity significantly reduces both the maximum settlement within the loading zone and its distribution beyond the loaded area. The proposed approach provides an efficient engineering methoed for predicting foundation performance under realistic soil conditions with sufficient accuracy for practical applications.

The proposed approach provides an efficient engineering methoed for predicting foundation performance under realistic soil conditions with sufficient accuracy for practical applications, contributing to Sustainable Development Goal (SDG) 9 (Industry, Innovation and Infrastructure) by supporting resilient and reliable infrastructure design, SDG 11 (Sustainable Cities and Communities) through safer and more sustainable foundation solutions in urban development, and SDG 13 (Climate Action) by enabling optimized material use and long-term performance assessment of geotechnical systems under changing environmental conditions.