

LETTER TO THE EDITOR

Stresses and displacement patterns for circular horizontal anchors embedded in a finite elastic medium

Jyant Kumar and P. Jagannatha Rao, *Geotechnical Engineering Division, Central Road Research Institute, New Delhi*

KEYWORDS: anchors; elasticity; finite elements; foundations; ground movements; numerical modelling and analysis.

Horizontal anchors in the form of circular discs are often used to withstand tensile forces acting on the foundations of structures such as transmission towers, dry docks and pipelines under water. Apart from determining the magnitudes of ultimate pull-out loads using different theories, investigations under working loads have been performed to examine the load deformation response of anchors (e.g. Fox, 1948; Selvadurai, 1976; Rowe & Booker, 1979). In this contribution the stress components and vertical displacement patterns are investigated, using finite element analysis, for a vertically uplifted, smooth, infinitely flexible, circular disc embedded horizontally (Fig. 1) in a linear elastic half-space which rests on, but is not bonded to, an underlying, otherwise fully-bonded, rigid stratum.

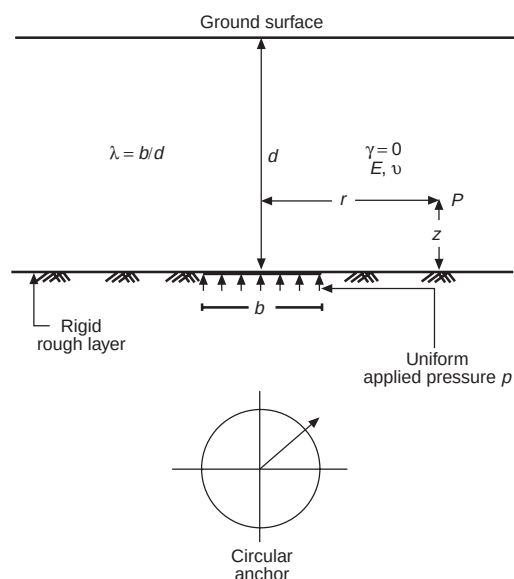


Fig. 1. General geometric details

The problem was analysed using Galerkin's finite element approach with the domain discretized into three-noded axisymmetric triangular elements. The results are presented in the form of the dimensionless influence coefficients vertical displacement $v = Iv (pb/E)$, radial normal stress $\sigma_r = I\sigma_r p$ and hoop stress $\sigma_\theta = I\sigma_\theta p$, where Iv , $I\sigma_r$ and $I\sigma_\theta$ are the appropriate influence coefficients, b is the diameter of the disc, p is the applied pressure on the disc and E is the elastic modulus.

The variation of the influence coefficients for vertical displacement along the axis of the disc and along the ground surface is shown in Figs 2 and 3 respectively. Figure 4 shows the variation of influence coefficients for radial and hoop stresses along the axis of disc.

The effect of pulling the disc is significant mainly within a distance $2b$ above the disc. Changes in the magnitude of Poisson's ratio ν

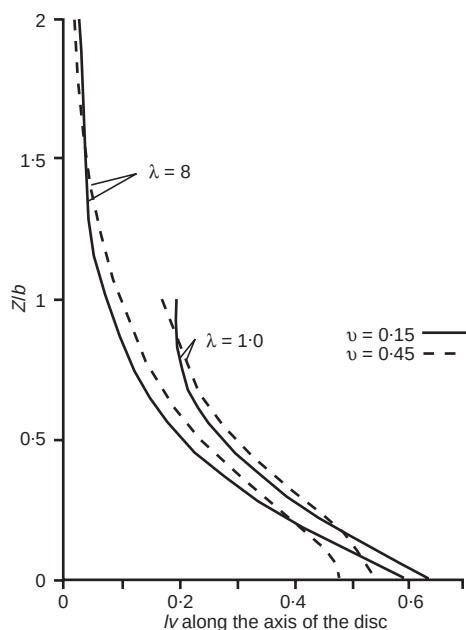


Fig. 2. Vertical displacement along the axis of the disc

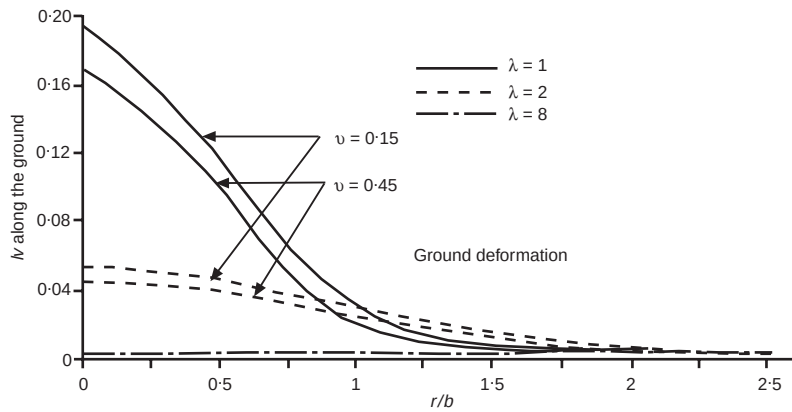


Fig. 3. Vertical displacement of the ground surface

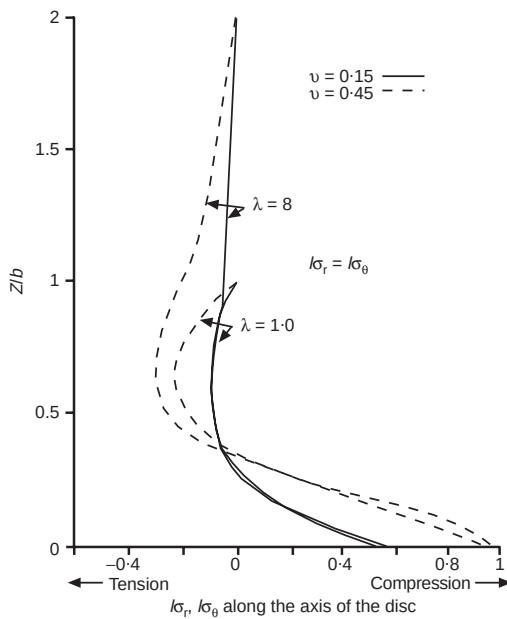


Fig. 4. Radial and hoop stresses along the axis of the disc

hardly affect the displacements, particularly at greater distances from the disc. Ground surface displacements are considerable only for a zone within a radial distance b from the axis of the anchor. For burial depths greater than $2b$, the magnitudes of ground surface displacements become negligible. Radial and hoop stresses along the axis of the disc are always equal; they remain compressive in a zone close to the disc, but become tensile at greater distances, maximizing at about $0.5b$ to $0.7b$ above the disc. Vertical normal stress changes were also found to remain insignificant at levels of more than $2b$ above the disc.

REFERENCES

- Fox, E. N. (1948). The mean elastic settlement of a uniformly loaded area at a depth below the ground surface. *Proc. 2nd Int. Conf. Soil Mech.* **1**, 129.
- Rowe, R. K. & Booker, J. R. (1979). A method of analysis for horizontally embedded anchors in an elastic soil. *Int. J. Numer. Analyt. Meth. Geomech.* **3**, 187–203.
- Selvadurai, A. P. S. (1976). The load–deflection characteristics of a deep rigid anchor in an elastic medium. *Géotechnique* **26**, No. 4, 603–612.