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A THEORETICAL ESTIMATE OF THE TILT OF A SURFACE FOUNDATION DUE TO AN INCLINED ANCHOR LOAD APPLIED AT THE INTERIOR OF THE SOIL MEDIUM

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SUMMARY

This paper examines the problem of the interaction between a loaded rigid circular foundation located at [redacted]

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[redacted]

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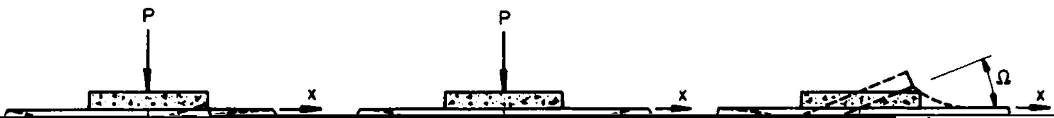
load are combined with the existing solution for the vertical anchor load to develop explicit results for the settlement and tilt of a surface foundation due to an inclined anchor load.



[redacted]

equation completes the formal analysis of the problem (see e.g. Sneddon[20]); i.e.

$$D(\xi) = \frac{2}{\pi \xi^3} \int_0^a \left\{ \frac{1}{t} \frac{\mathrm{d}}{\mathrm{d}t} \int_0^t \frac{r^2 f(r)\,\mathrm{d}r}{\sqrt{(t^2 - r^2)}} \right\} \sin(\xi t)\,\mathrm{d}t \tag{15}$$

Formal integral expressions can now be obtained for the displacement and stress fields in the medium ($\mathbf{u}(r, \theta, z)$ and $\boldsymbol{\sigma}(r, \theta, z)$) in terms of the function $D(\xi)$ defined by (15).

The result of primary interest to this paper concerns the evaluation of the resultant rotation experienced by the rigid circular foundation due to the internal horizontal anchor force. To develop this result we make use of the expression for the moment M_x exerted on the rigid circular foundation by the contact stresses $\sigma_{zz}(r, \theta, 0)$. Since the foundation is subjected to zero external moment we require

$$M_x = \int_0^a \int_{-\pi}^{\pi} \frac{1}{a^4} \left\{ \int_0^\infty \xi^3 D(\xi) J_1(\xi r/a)\,\mathrm{d}\xi \right\} r^2 \cos^2\theta\,\mathrm{d}r\,\mathrm{d}\theta = 0 \tag{16}$$

Evaluating (16) we obtain the following expression for the rotation of the rigid circular [redacted]

Evaluating (19) we obtain

$$\sigma_{zz}^{h} = \frac{Q_h r \cos\theta H(r, c)}{2\pi^2 a^2 (1-\nu)\sqrt{(a^2-r^2)}} \tag{20a}$$

where

$$H(r, c) = 3\left\{2(1-\nu)\frac{c}{a}\tan^{-1}\left(\frac{a}{c}\right) - \frac{c^2}{(a^2+c^2)} - (1-2\nu)\right\}$$
$$+\frac{a^2}{(r^2+c^2)}\left\{2(1-2\nu)[1+\beta\tan^{-1}\beta] - \frac{c^2}{(r^2+c^2)}\left[2\frac{(r^2+c^2)}{(a^2+c^2)} + 3\tan^{-1}\beta\right]\right\} \tag{20b}$$

and

$$\beta = \sqrt{\left[\frac{a^2-r^2}{(r^2+c^2)}\right]} \tag{20c}$$

[redacted]

The results presented in the preceding section for the horizontal anchor load can be combined with the results already available for the vertical anchor load (Selvadurai[17]) to produce a [redacted] where

$$w_0 = \frac{P(1-\nu)}{4aG} - \frac{Q(1-\nu)\cos\zeta}{4aG}\left[\frac{2\tan^{-1}}{\pi}\left(\frac{a}{c}\right) + \frac{ac}{\pi(1-\nu)(a^2+c^2)}\right] \tag{22a}$$

$$\Omega = \frac{3Q\sin\zeta}{8\pi Ga^2}\left[2(1-\nu)\frac{c\tan^{-1}}{a}\left(\frac{a}{c}\right) - \frac{c^2}{(a^2+c^2)} - (1-2\nu)\right] \tag{22b}$$

The results given here are applicable to the situation where a single anchor force acts at the interior of the soil mass. The analysis can, however, be easily extended to the problem of a series of individual anchors or a distribution of anchor loads located along the z-axis by a superposition of the solution (21). The normal contact stress at a foundation–elastic medium interface is given by

$\sigma_{zz}(r, \theta, 0) = \frac{P}{\ldots} + \frac{Q\cos\zeta V(r,c)}{\ldots} + \frac{Qr\sin\zeta\cos\theta H(r,c)}{\ldots}$ (23)

[redacted]

settlement of the rigid foundation due to the axisymmetric load P is 3.125 mm. Owing to the

[redacted]

Mechanics—I, Ed. C. R. Scott, 317–346, Applied Science Publ. London 1978.
2. J. Boussinesq, *Applications des Potentiels*, Gauthier-Villars, Paris, 1885.
3. G. M. L. Gladwell, 'A contact problem for a circular cylindrical punch in adhesive contact with an elastic halfspace:

[redacted]