Finally the author has been able to determine, in certain cases concerning maximum ortholisthenes, an upper limit (very approximative be it said) of the error made by considering the factor m as unity. He has given to the profiles thus obtained the name of 'maximum rectified ortholisthenic profiles'.

He shows that in a particular case the error resulting from adoption of simplified profiles is at greatest 8% and acts in favour of stability; it can thus be included in the margin of security which it is in any case essential to conserve in practical application of problems relating to the strength of materials.

REFERENCES

1) Reported to Academie des Sciences - 20 Feb. 1922 p.526,13 Mar.1922 p. 740,3 Apr.1922,p.930 and to memoranda submitted to the Congrès des Grands Barrages de Stockholm (1933) and Washington (1936).

2) From the Greek ἴσος ,equal and ὀλισθαίνειν , to slide.

3) Report to the Academie des Scienees, 11 June 1928 p.1597.

4) From the Greek ὀρθός,straight, ὀλισθαίνειν , to slide.

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I e 20

GENERAL THEORY OF THE BEARING CAPACITY OF PILES

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SYNOPSIS OF THE FRENCH REPORT

We have already given the mathematical elements for the calculation of the bearing capacity of piles x). They are founded on an approximate value of the passive soil pressures. The complete calculation of passive pressures tables that we have just finished now makes it possible to obtain a firmer grip of the elements of the problem.

The bearing capacity of a foundation in a medium of internal friction angle φ and specific weight ω is the sum of three terms :

1) A surface term expressed by $s\,\omega\,\rho\, f(\varphi)$ proportioned to the mean radius ρ and the foundation surface S, an invariable term whatever the depth, remaining alone where penetration is nil.

The numerical calculation of the passive pressure, exerted by a soil with a free horizontal surface on a screen situated in the plane of the free surface gave us for f (φ) the following expression:

$$0,384\ tg^2\left(\frac{\pi}{4}+\frac{\varphi}{2}\right)\left(e^{4,55\ tg\varphi}-1\right)$$

For piles this term is negligible compared with those that follow, because the mean radius ρ is very small when compared with the depth h.

2) A pile point resistance term of the form $s\,\omega\, h\, g(\varphi)$ proportional to depth h.

3) A lateral friction term of the form

$P.\frac{1}{2}\,\omega h^2\ K\ tg\,\varphi$ proportional to the square of depth h,P being the perimeter of a section and K the normal component of the soil passive pressure acting obliquely on a vertical screen from a mass with a free horizontal surface.

The numerical calculation of the passive pressure table has shown us that K can be represented by the expression :

$$K = e^{19/30\ tg\varphi}\left(4 + tg\,\varphi^{\frac{2}{3}}\right)$$

from which one deduces for $g(\varphi)$ the expression

$$\left(I + 0,32\ tg^2\varphi\right) tg^2\left(\frac{\pi}{4}+\frac{\varphi}{2}\right)e^{\pi tg\varphi}$$

It differs from the classical expression

$$tg^2\left(\frac{\pi}{4}+\frac{\varphi}{2}\right)e^{\pi tg\varphi}$$

in the multiplicator $\left(I + 0,32\ tg^2\varphi\right)$ xa)

This coefficient takes into account the fact that on the horizontal plane of the foundation, and continuing on either side of it, the stress exerted, owing to the soil above, is not vertical.

But, if the pile is driven into a soil of angle φ , topped by a soil of angle $\varphi' < \varphi$ this multiplying coefficient can be brought down to unity for φ'=0.So we therefore suggest the following general formula for the bearing capacity of piles:

Point resistance (1)

$$\omega\, h\left(I + 0,32\ tg^2\varphi'\right) tg^2\left(\frac{\pi}{4}+\frac{\varphi}{2}\right)e^{\pi tg\varphi}$$

Lateral resistance (2)

$$P.\tfrac{1}{2}h^2\ tg\varphi' e^{19/30\ tg\varphi'}\left(4 + tg\,\varphi'^{\frac{2}{3}}\right)$$

φ' and φ being the angles of friction of the soil situated respectively above and below the foundation plane.

x) A. Caquot, Equilibre des massifs à frottement interne, (Equilibrium of large bodies with internal friction)- Paris, Gauthier-Villars 1934.
J. Lehuerou-Kerisel, La force portante des pieux (The bearing capacity of piles) Annales des Ponts et Chaussées 1938 No 21.

xa) The value of this coefficient is 1,32 for φ = 45° Here is the explanation of the DELFT laboratory experimental coefficient 1.3

DISTRIBUTION BETWEEN THE TWO TERMS

The two above terms are not, in fact, independent. Our experiments in homogenous media show, beyond all question, that if the lateral resistance term decreases, that of the point resistance increases, the total remains unchanged and is represented, in any case, by the parabolic expression which is the sum of the two expressions (1) and (2) given above. This interdependence and compensation are easily explained. We have assumed that the limit of the area of equilibrium above and around the point in the mass was the continued horizontal plane of the foundation. This is not exactly the case: the lines of failure in the equilibrium of passive pressure at the point turns up (fig. 1) over the horizontal plane to reach the lateral surface of the pile with increasing obliquity of angle from the negative friction near the lower edge to the positive friction which acts in the same direction as the passive pressure of the upper mass. The balance of vertical stress in all or part of this zone is negative as has been shown by the experiments of CAMBEFORT, LHERITEAU and FLORENTIN, and it is understandable that by contraction or enlargement of this lateral surface zone there is a possibility of interdependence and compensation of the variations of the two terms, of point resistance and of lateral friction.

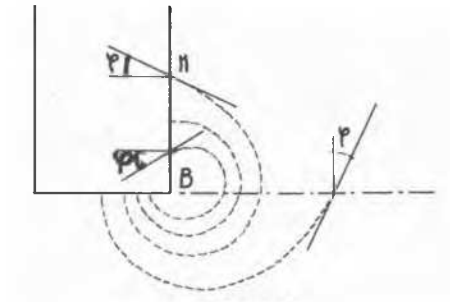

FIG. 1

The use we have made of the calculation methods for ground thrust tables makes it possible to determine these exchanges quantitatively. The importance of these exchanges appears to be secondary when it comes to calculating the total bearing capacity avaible, which in any case is equal to the sum of the expressions (1) and (2) with φ and φ' taken at their proper values.

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