The determination of breaking surfaces in an earth prism, using the regression criteria

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1. Introduction

This work presents the last results of the authors in respect to the ground breaking surfaces, this time being considered a distributed load on a half-plan. The work continues ours researches on earth stability (Zarojanu 2008, Zarojanu et al 2008).

In the situation of a half-plan charged by a distributed load - a common situation, mainly of the roads structures loaded by wheels charges – this work supposes, that the points which get an ultimate equilibrium, could describe also the contour of the breaking surface.

In that case, the problem consists to find out these points, using the Mohr-Coulomb criterion (Stanciu&Lungu 2006). That means to build the Mohr circle with the unit principal stresses as well as the Coulomb straight-line with the ground cohesion and the ground internal friction values. The next step is to impose the contingence of the Mohr circle and the Coulomb straight line.

The situation above, can be simulated as a half-plane charged by a distributed load (*Fig.1*).

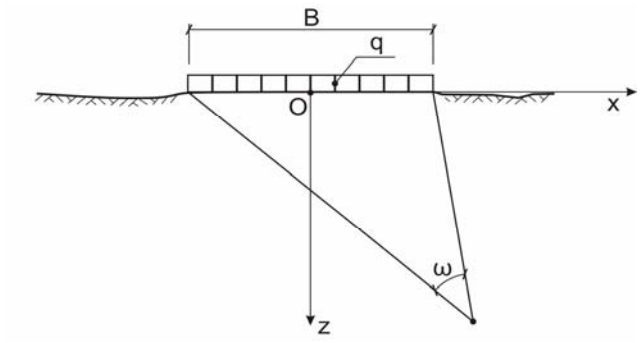

Figure 1. Half-plane charged by a distributed load

2. Material and methods

2.1 The determination of the unit principal stresses. The ultimate equilibrium condition

The form of principal unit stresses is already known in case of a distributed charge on a half-plane (1):

$$\sigma_{1,2} = \frac{q}{\pi} \cdot (\omega \pm \sin \omega) \text{ , where:}$$

(1)

q – the distributed load;

ω - the sight angle;

The ultimate Mohr–Coulomb equilibrium condition consists in the contingence between the Coulomb straight-line and the Mohr circle built with the stresses produced by the considered charge case (Zarojanu 2008, Zarojanu et al 2008)(*Fig. 2*).

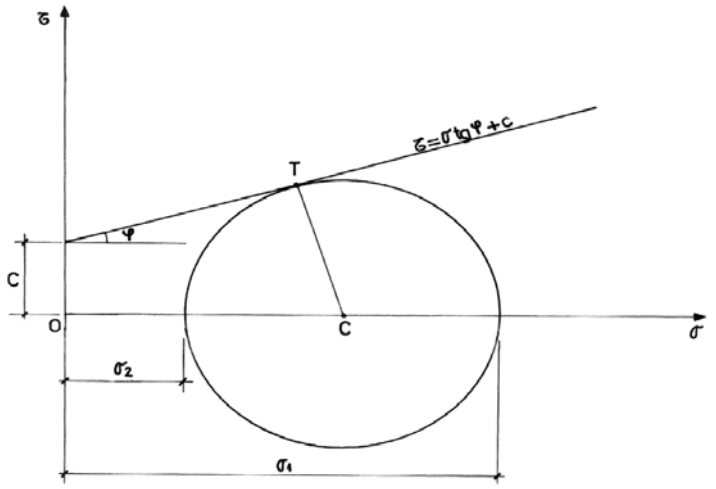

Figure 2. The Mohr – Coulomb ultimate equilibrium condition

In Fig. 2 there are the folowing significations:

φ - the internal friction angle of the ground;

c – the cohesion of the ground;

σ , τ - the unit compression stress and the unit shearing stress;

Analytically, the contingence condition becomes (Stanciu&Lungu 2006):

$$\sin \omega \cdot \cos \varphi - \omega \cdot (1 - \sin \omega) \cdot tg\varphi = \frac{c \cdot \pi}{q}$$

(2)

From the equation (2) gets the sight angle:

$$(c\pi/q+\cos\varphi)/[(1-\sin\varphi)tg\varphi \leq \omega \leq (\cos\varphi-c\pi/q)/[(1-\sin\varphi)tg\varphi]$$

(3)

In order to find out the condition to have a breaking surface, it could proceed as follows:

It is already known that in case of a half-plane charged by a distributed load, the principal unit stresses paths (the isostatical curves) have the folowing shapes (Fig. 3):

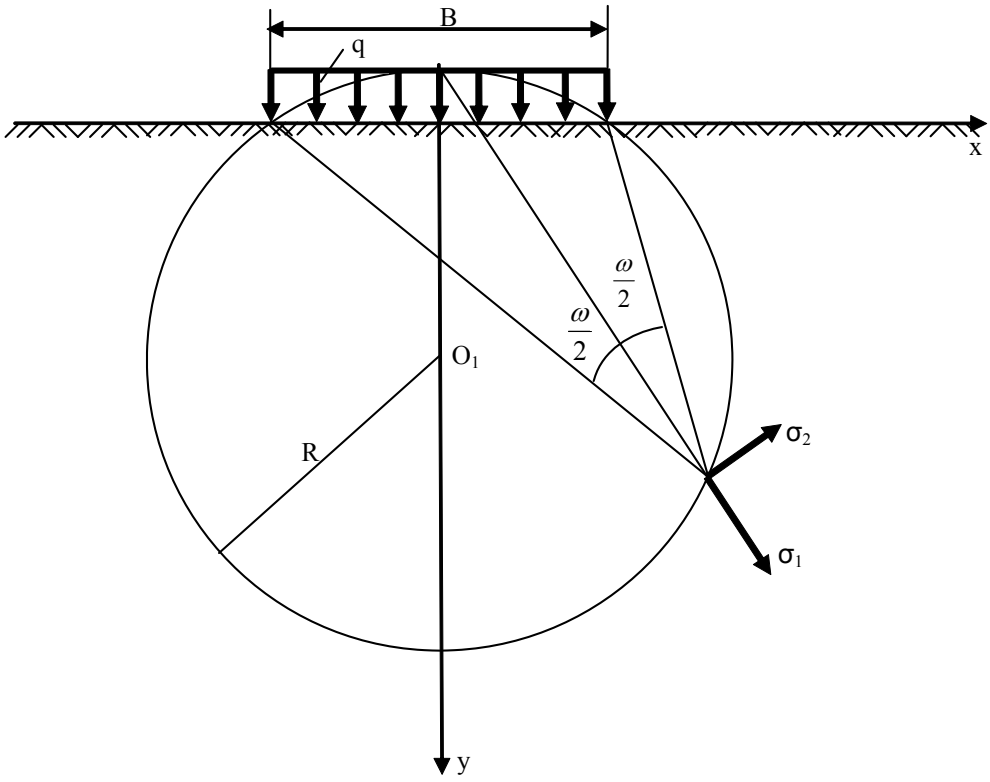

Figure 3. The isostatical curve of the unit principal stresses

That means that the principal stresses pairs that verify the Mohr-Coulomb criterion are on an isostatical curve that is a circle whose radius must be found out.

The length *B* of the distributed charge is known, as well as the sight angle.

2.2. The determination of the sight angle

From the *Fig.3* it could write:

$$sin\ \omega = \frac{B}{2R} \tag{4}$$

Because of (2), it can obtain R – the radius of the curve that describes the contour of the breaking surface (the radius of the isostatical curve where the values σ_1, σ_2 are, verifying the Mohr – Coulomb criterion), the sight angle being already found out as it was shown above.

From (2):

$$R = \frac{B}{2\omega(1-\sin\varphi)\cdot\dfrac{\sin\varphi}{\cos^2\varphi}+\dfrac{2c\cdot\pi}{q\cdot\cos\varphi}} \tag{5}$$

3. Results

The contour of the breaking surface is a circle (Fig. 3);

The sight angle, because the characteristics of the ground, may have, sometimes, several values; that means there are several curves that could describe the contour of the breaking surface.

4. Discussion

The contour of the breaking surface is a circle, because the shape of the isostatical curve;

The sight angle, because the characteristics of the ground, may have, sometimes, several values; that means there are several curves that could describe the contour of the breaking surface. In that situation, the egression criteria are not enough, they must be completed with peculiar earth characteristics;

5. Conclusion

The egression criteria, mainly the Mohr Coulomb criterion, could be used to determine a breaking surface;

For the sight angle determination, sometimes, could be necessary, to complete the egression criteria with peculiar earth characteristics;

References

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Abstract

The determination of breaking surfaces in an earth prism, using the regression criteria

The paper refers to the situation of a ground charged by a distributed load. It supposes, that the total of the points, which are in an ultimate equilibrium, limits a segment of unstable ground. Therefore, these points can also describe the breaking surface. This work continues the researches of the authors on grounds stability. This time is considered the case of the distributed loads on a half-plan and the determination of the points, which are in ultimate equilibrium, is done by the help of the plastic yielding criteria.

Keywords: earth breaking surfaces, ultimate equilibrium

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