53:139 Foundations of Structures
Spring Semester, 2 0 0 0
The University of Iowa
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Supplement to Homework Assignment #3

Problem 3a: A number of possible failure or slip surfaces can be used to analyze bearing capacities of shallow foundations. One of the many that has been considered is the planar semi-circular surface. Using equilibrium considerations like those used in class, derive an expression for the ultimate bearing capacity **P** of a strip footing of width B in terms of B, γ, c, and D. Assume the following:

i. a rotational slip failure in the soil along the semi-circular surface centered at O. The extended failure surface passing through the surcharge is assumed to be vertical.
ii. the soil and the surcharge have unit weight γ, nonzero cohesion c and a friction angle $\phi = 0$.
iii. friction between the soil and the foundation is negligible.
iv. shear along the surface passing through the surcharge is not negligible.

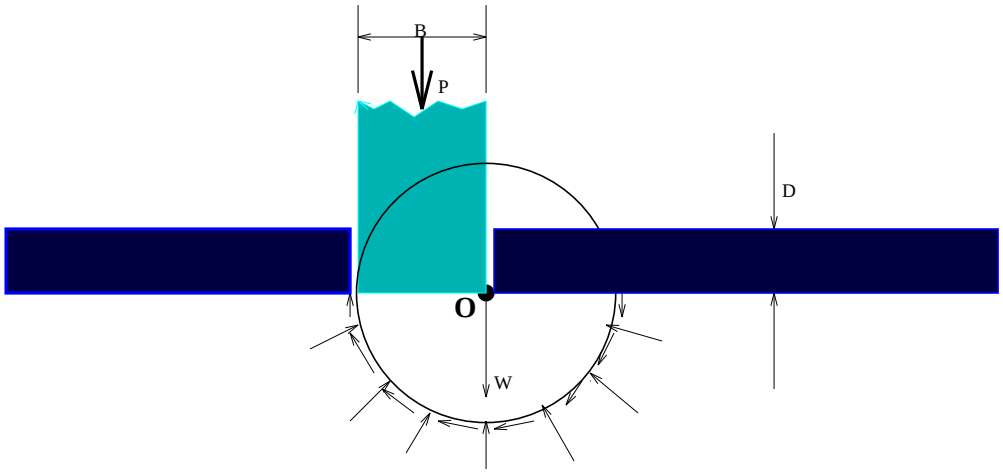

Figure 1. Shallow foundation with semi-circular slip surface in soil.

Problem 3b: In deriving Terzaghi's bearing capacity equations, we used the notion of Rankine's passive failure state where:

$$\sigma'_H = K_p \sigma'_V + 2c\sqrt{K_p}$$

$$K_p = \tan^2(45 + \frac{\phi}{2})$$

$$\theta_{\text{failure}} = 45 - \frac{\phi}{2}$$

Using Mohr's circle and the Pole method, verify these results. Briefly explain how this result is used in Terzhagi's theory.