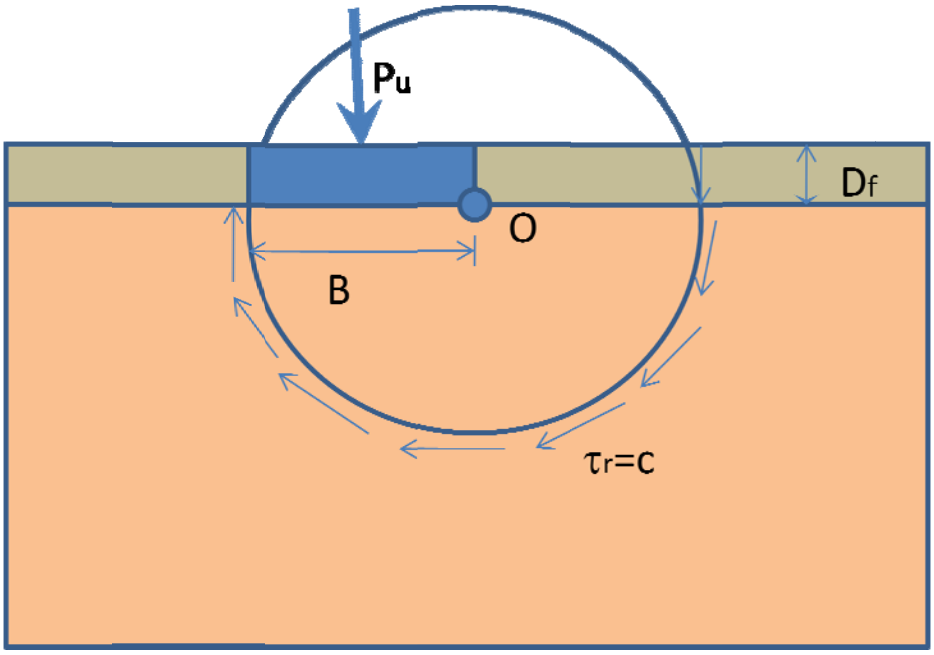
53:139 Foundation Engineering

Department of Civil & Environmental Engineering

The University of Iowa

Supplement to Assignment #4

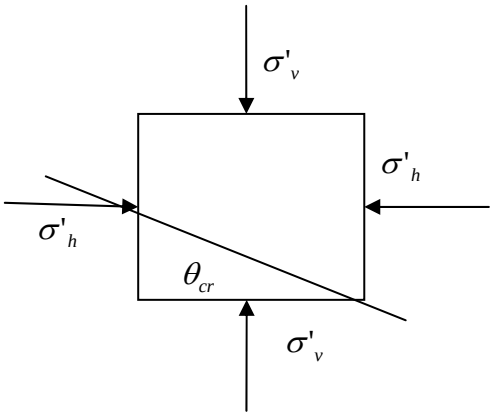
Problem #1: A number of possible failure or slip surfaces can be used to analyze bearing capacities of shallow foundations. One of the many that has been considered for strip footings is the planar semi-circular surface shown below. Bearing failure of the soil for this slip surface involves rotation of the soil mass about the point O at the corner of the footing. The force P_u is the bearing capacity and drives the failure. Three mechanisms resist failure: (1) the surcharge loading to the right of the foundation; (2) the cohesion stress in the surcharge layer τ_r=c; and (3) the cohesion stress τ_r=c along the circular surface of the mechanism. Using equilibrium considerations like those used in class, derive an expression for the ultimate bearing capacity P_u of a strip footing of width B in terms of B, γ, c, and D_f.



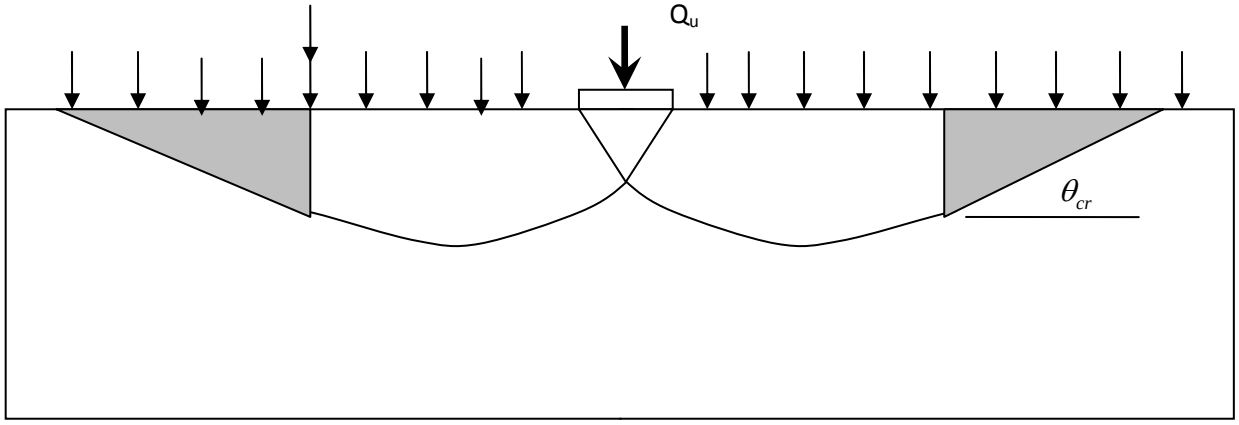
Problem #2: In deriving Terzaghi's bearing capacity equation for strip footings, we used the notion of Rankine's passive failure state in which:

$$\sigma'_h = K_p \sigma'_v + 2c\sqrt{K_p} \quad \text{where} \quad K_p = \frac{1+\sin\phi}{1-\sin\phi} = \tan^2\left(45^\circ + \tfrac{\phi}{2}\right)$$

Shear failure occurs in the soil along planes making angles with the horizontal: $\theta_{cr} = \pm\left(45^\circ - \tfrac{\phi}{2}\right)$



This was used in developing Terzaghi's bearing capacity model for strip footings in which the assumed failure mechanism in the soil was as shown below.



Using Mohr's circle and the Pole method, first verify the equations above. Then explain how this result was used in developing Terzhagi's bearing capacity equation.