LECTURE 35

Vane Shear Test:

Fairly reliable results for the undrained shear strength, c,, (S : 0 concept), of very soft to medium cohesive soils may be obtained directly from vane shear tests. The shear vane usually consists of four thin, equal-sized steel plates welded to a steel torque rod. First, the vane is pushed into the soil. Then torque is applied at the top of the torque rod to rotate the vane at a uniform speed. A cylinder of soil of height ft and diameter r/ will resist the torque until the soil fails. The undrained shear strength of the soil can be calculated as follows. If I is the maximum torque applied at the head of the torque rod to cause failure, it should be equal to the sum of the resisting moment of the shear force along the side surface of the soil cylinder (M.) and the resisting moment of the shear force at each end (M,,)

$$T = M_s + \underbrace{M_e + M_e}_{\text{Two ends}}$$

The resisting moment can be given as

$$M_s = \underbrace{(\pi d h) c_u}_{\text{Surface area}} \underbrace{(d/2)}_{\text{Moment arm}}$$

where d : diameter of the shear van c/z : height of thc shear vane

For the calculation of M., investigator sh avea everal t ypeso f distributicln of shear strength mobilization at thc ends of the soil cylinder:

l. Triangular. Shear strength mobilization is c,, at the periphcry of the soil cylinder and decreases lineaarly to zero at the center.

2, IJni.form.S hears trengthm obilization is constant (that is, c)f rom the periphery to the center of the soil cylinder.

3. Parabolic. Shear strength mobilization is c,, at the periphery of the soil cylinder and dccreases parabolically to zero at the center.

These variations in shear strength mobilization are shown in Figure .In general, the torque,I at failure can be expressed as

$$T = \pi c_u \left[\frac{d^2 h}{2} + \beta \frac{d^3}{4} \right]$$

$$c_u = \frac{T}{\pi \left[\frac{d^2 h}{2} + \beta \frac{d^3}{4} \right]}$$

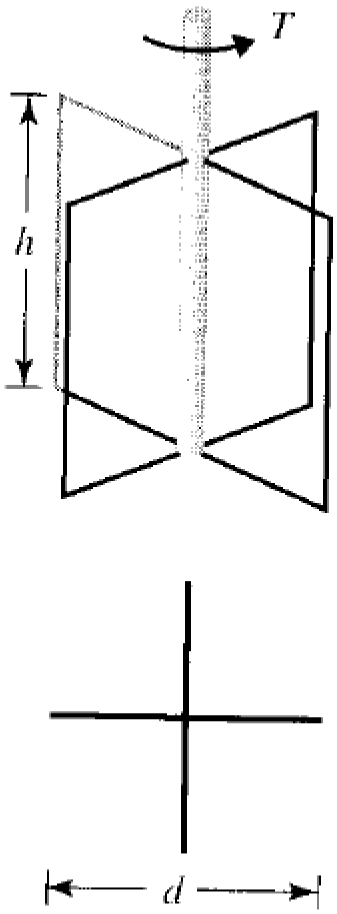
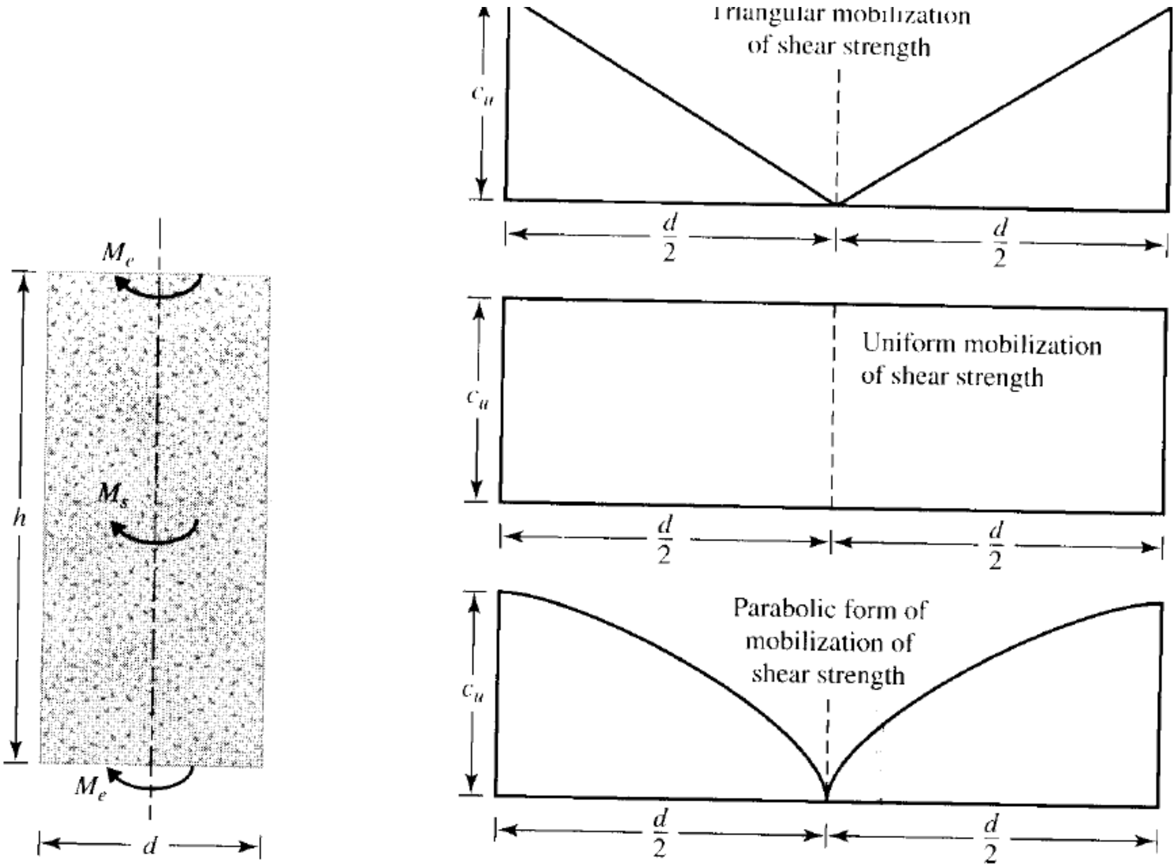


Diagram of vane shear test equipment



(a) resisting moment of shear force; (b) variations in shear strength mobilization

$$c_u\,(\mathrm{kN/m^2}) = \frac{T\ (\mathrm{N \cdot m})}{(366 \times 10^{-8})\underset{\substack{\uparrow \\ (\mathrm{cm})}}{d^3}}$$

$$c_u\,(\mathrm{lb/ft^2}) = \frac{T\ (\mathrm{lb \cdot ft})}{0.0021\underset{\substack{\uparrow \\ (\mathrm{in.})}}{d^3}}$$