4.5 VANE SHEAR TEST:

- Vane shear test is a quick test, used either in the lab (or) in the field, to determine theundrained shear strength of cohesive soils.
- The vane shear tester consists of four thin steel plates called vanes, weldedorthogonally to a steel rod.
- A torque measuring arrangement is attached to the rod which is rotated by a wheelarrangement.
- After pushing the vanes gently into the soil, the torque rod is rotated at a uniformspeed.
- The torque 'T' is then calculated by multiplying the dial reading with the springconstant.
- The vane is 20mm high and 12mm in diameter with thickness of 0.5 to 1mm.
- The field shear vane is 10 to 20cm in height and from 5 to 10cm in diameter, withthickness of about 2.5mm.

$$T = \pi d^2 \tau_f [H / 2 + d / 6]$$

Let, τ_f be the shear strength of soil,

$$\tau_f = \frac{T}{\pi D^2 (\frac{H}{2} + \frac{D^3}{6})}$$

If only bottom end partakes in the shearing, then

$$T = \pi d2 \tau_f [H / 2 + d / 12]$$

$$\tau_f = \frac{T}{\pi D^2 (\frac{H}{2} + \frac{D^3}{12})}$$

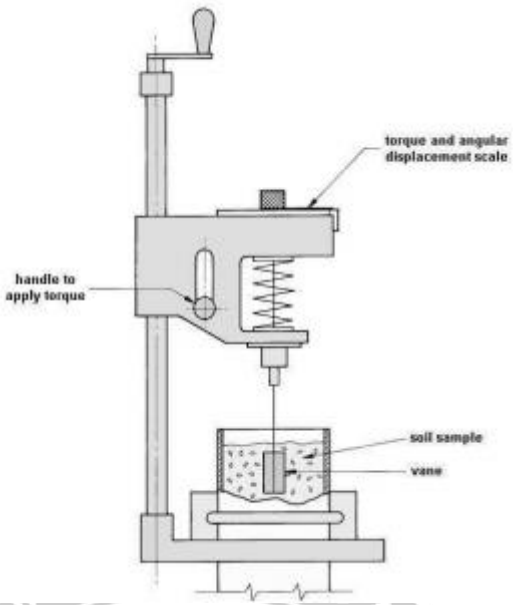

Fig 4.5.1 vane shear

1)A shear vane of 7.5 cm diameter and 11 cm length was used to measure the shear strength of a soft clay. If a torque of 600 N-m was required to shear the soil, Calculate the shear strength. The vane was rotated rapidly to cause remoulding of the soil. The torque required in the remoulded state was 200N-m Determine the sensitivity of the soil.

Solution:

In natural state:

$$c\ or\ \tau_f = \frac{T}{\pi D^2\left(\frac{H}{2}+\frac{D^3}{6}\right)}$$

$$= \frac{4500}{\pi x 8^2\left(\frac{10}{2}+\frac{(7.5)^3}{6}\right)x10^{-6}}$$

$=503\ KN/m^2$

In the remoulded state,

$$c\ or\ \tau_f = \frac{200x10^{-3}}{\pi x 7.5^2\left(\frac{11}{2}+\frac{(7.5)^3}{6}\right)x10^{-6}}$$

$=168\ KN/m^2$

$$Sensitivity = \frac{c(\text{ natural state})}{c(\text{ remoulded state})}$$

$$Sensitivity = \frac{503}{168} = 3$$

2)A vane 10cm long and 8cm in diameter was pressed into soft clay at the bottom of a bore hole. Torque was applied and gradually increased to 45N-m.When failure takes place .Subsequently, the vane rotated rapidly so as to completely remould the soil. The remoulded soil was sheared at a torque of 18 N-m. Calculate the cohesion of the clay in the natural and remoulded state and also the value of sensitivity

Solution:

In natural state:

$$c \text{ or } \tau_f = \frac{T}{\pi D^2 (\frac{H}{2} + \frac{D^3}{6})}$$

$$= \frac{4500}{\pi x 8^2 \left(\frac{10}{2} + \frac{(8)^3}{6}\right)}$$

=35.4 KN/m^2 (φ=0)

In the remoulded state,

$$c \text{ or } \tau_f = \frac{1800}{\pi x 8^2 \left(\frac{10}{2} + \frac{(8)^3}{6}\right)}$$

=14.1 KN/m^2

$$Sensitivity = \frac{c(\text{ natural state})}{c(\text{ remoulded state})}$$

$$Sensitivity = \frac{35.4}{14.1} = 2.5$$

LIQUEFACTION:

Liquefaction is a phenomenon which can saturated in loose deposit of saturated fine a cohesion less soils. If a saturated fine sand deposit is subjected to a sudden disturbance as caused by vibrations of heavy machinery, blasting (or) earth quake, rapid decrease in volume takes place and the pore pressure may increase to such an extent that pore pressure may increase to such an extent that effective stresses become zero loading to complete loss of shear strength. The soil at this stage behaves like a liquid and the phenomenon is referred to as liquefaction.