LECTURE 30

SHEAR STRENGTH OF SOIL

Necessity of studying Shear Strength of soils :

• Soil failure usually occurs in the form of "shearing" along internal surface within the soil.

Shear Strength:

• Thus, structural strength is primarily a function of shear strength.

• The strength of a material is the greatest stress it can sustain

• The safety of any geotechnical structure is dependent on the strength of the soil

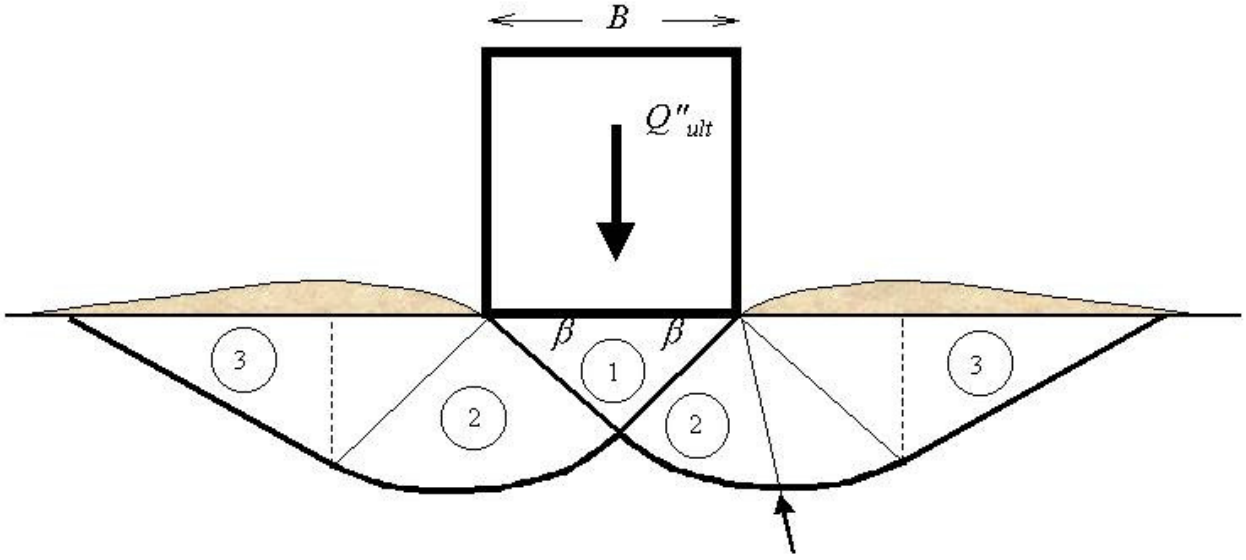
• If the soil fails, the structure founded on it can collapse

Thus shear strength is

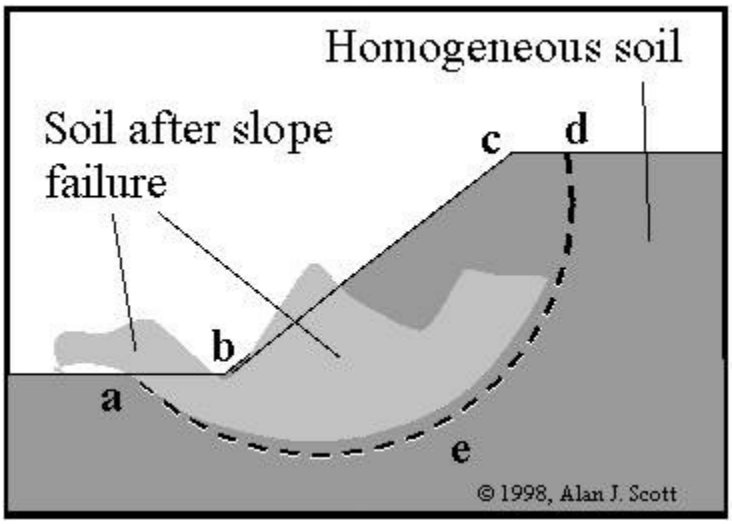
"The capacity of a material to resist the internal and external forces which slide past each other"

Significance of Shear Strength :

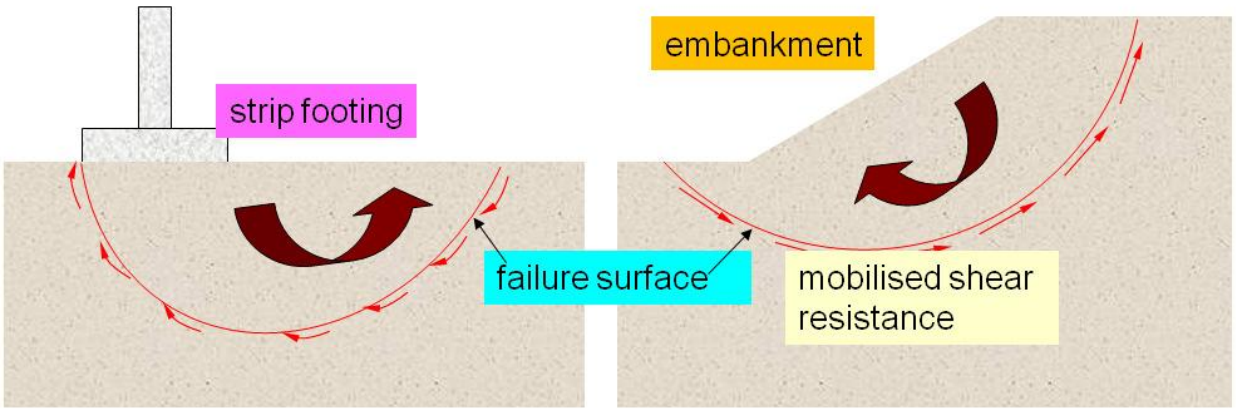
- Engineers must understand the nature of shearing resistance in order to analyze soil stability problems such as;
- Bearing capacity
- Slope stability
- Lateral earth pressure on earth-retaining structure



Shear Failure under Foundation Load



Slope Stability Failure as an Example of Shearing Along Internal Surface



At failure, shear stress along the failure surface reaches the shear

Thus shear strength of soil is

"The capacity of a soil to resist the internal and external forces which slide past each other"

Shear Strength in Soils :

- The shear strength of a soil is its resistance to shearing stresses.
- It is a measure of the soil resistance to deformation by continuous displacement of its individual soil particles.
- Shear strength in soils depends primarily on interactions between particles.
-Shear failure occurs when the stresses between the particles are such that they slide or roll past each other

Components of shear strength of soils

Soil derives its shear strength from two sources:

– Cohesion between particles (stress independent component)

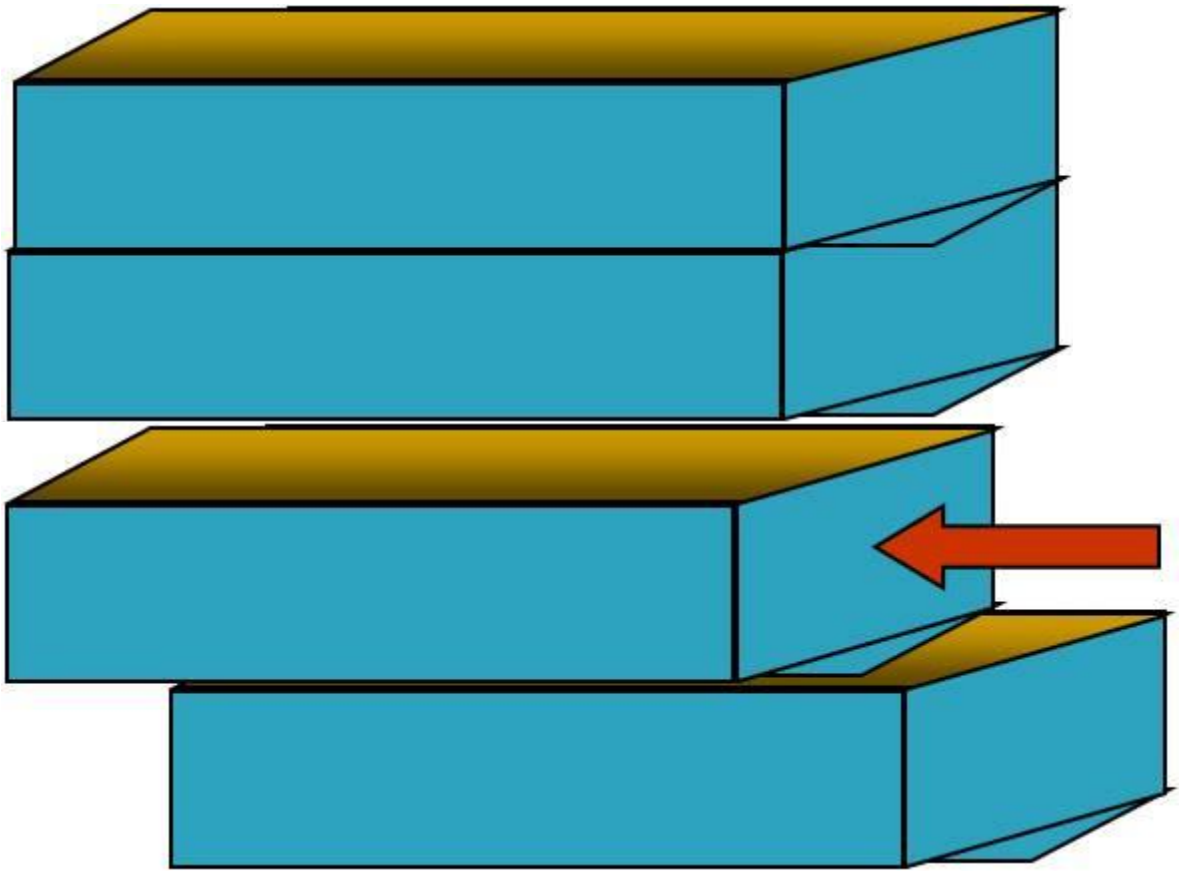
• Cementation between sand grains

• Electrostatic attraction between clay particles

– Frictional resistance and interlocking between particles (stress dependent component)

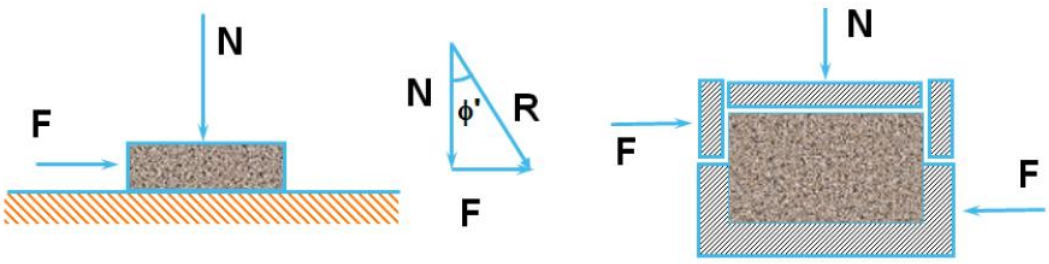
Cohesion :

Cohesion (C), is a measure of the forces that cement particles of soils



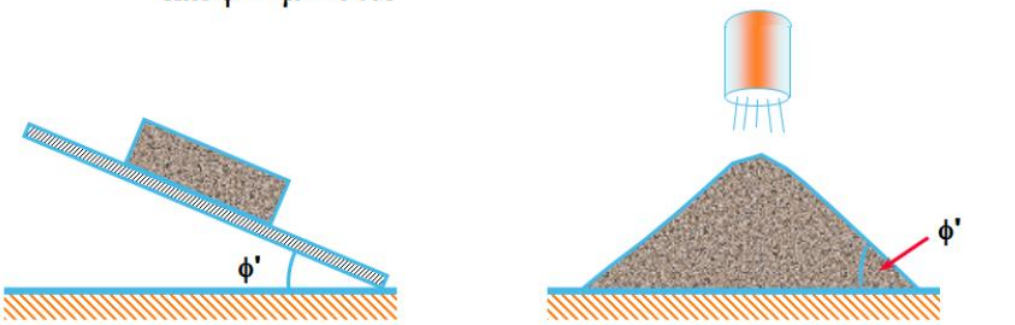
Internal Friction :

Internal Friction angle (*f*), is the measure of the shear strength of soils due to



ϕ': Angle of internal friction; μ: coefficient of friction

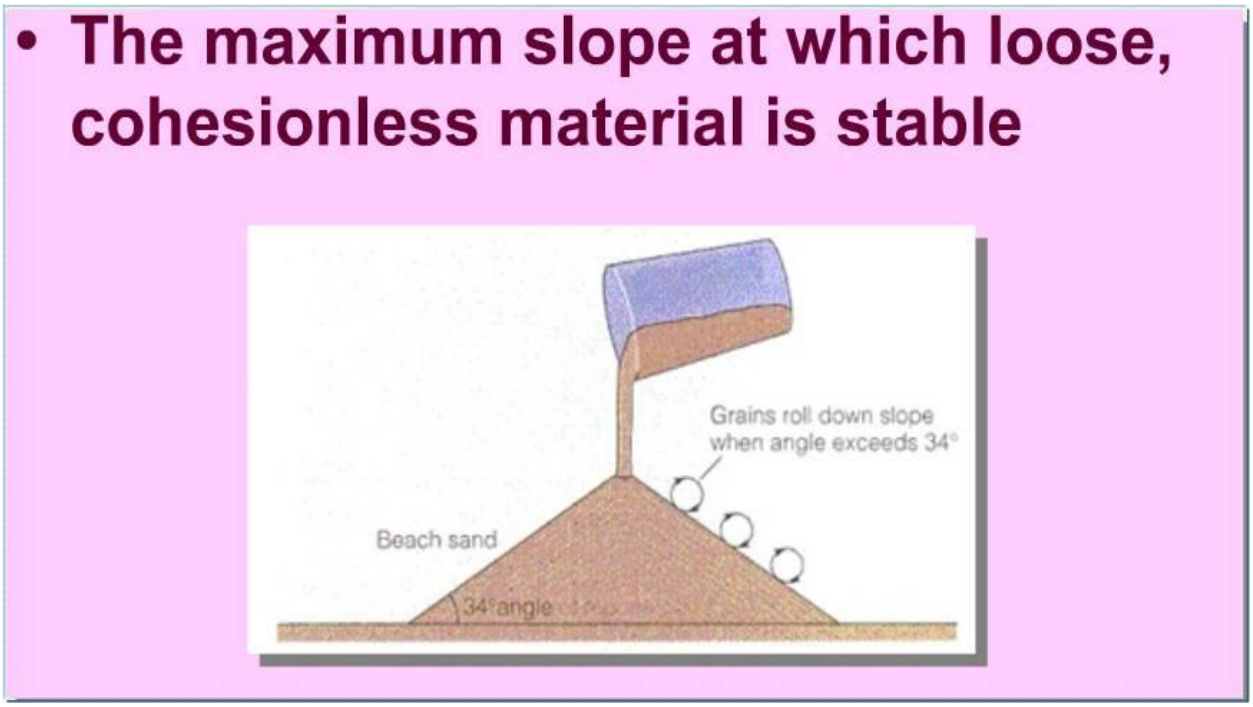
$\tan \phi' = \mu = F/N$



ϕ': Angle of plank when block slides

ϕ': Angle of repose of sand heap

friction



Angle of Repose

Angle of Repose determined by:

Particle size (higher for large particles)

Particle shape (higher for angular shapes)

Shear strength (higher for higher shear strength)

Stresses:

Gravity generates stresses (force per unit area) in the ground at different points. Stress on a plane at a given point is viewed in terms of two components:

Normal stress (σ) : acts normal to the plane and tends to compress soil grains towards each other (volume change)

Shear stress (τ): acts tangential to the plane and tends to slide grains relative to each other (distortion and ultimately sliding failure).