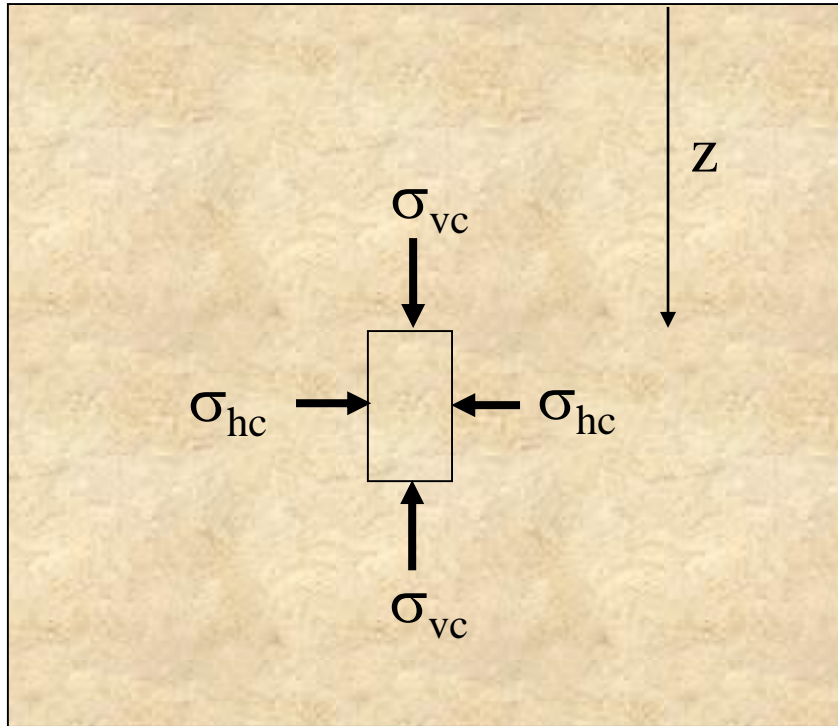


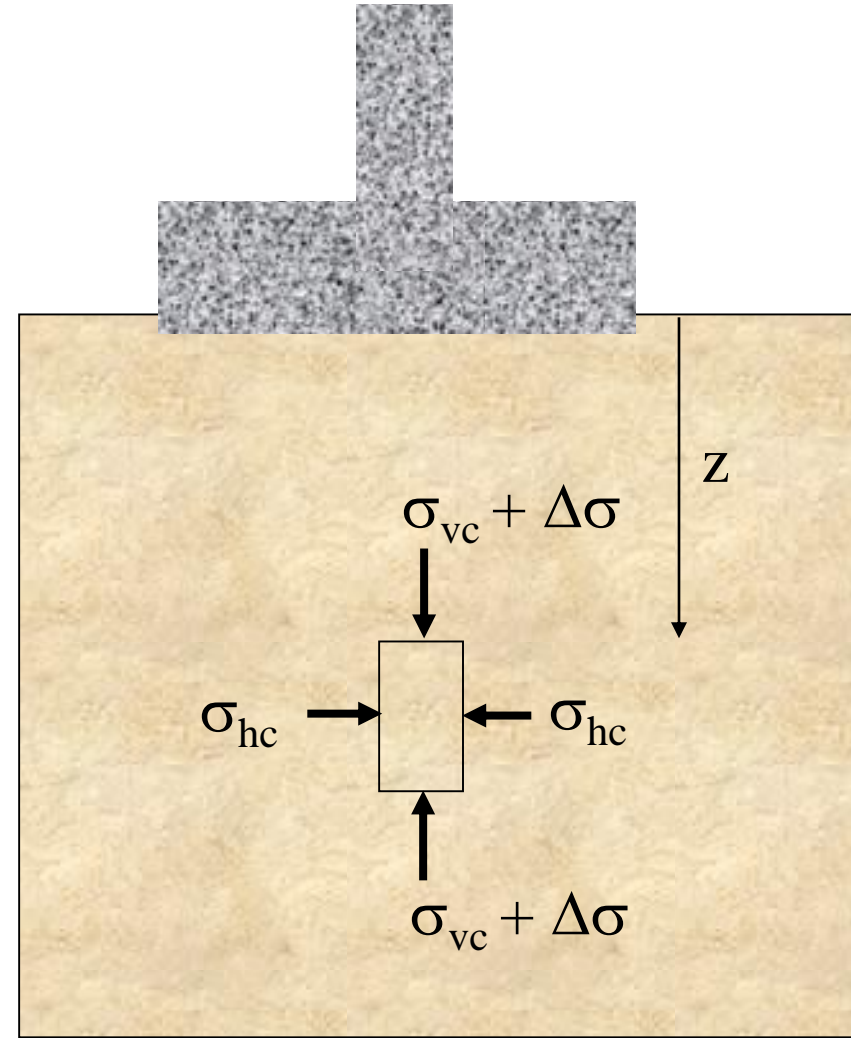
# **JFM304 Zemin Mekanikđi**

## **Zeminde Gerilmeler**

## Arazide

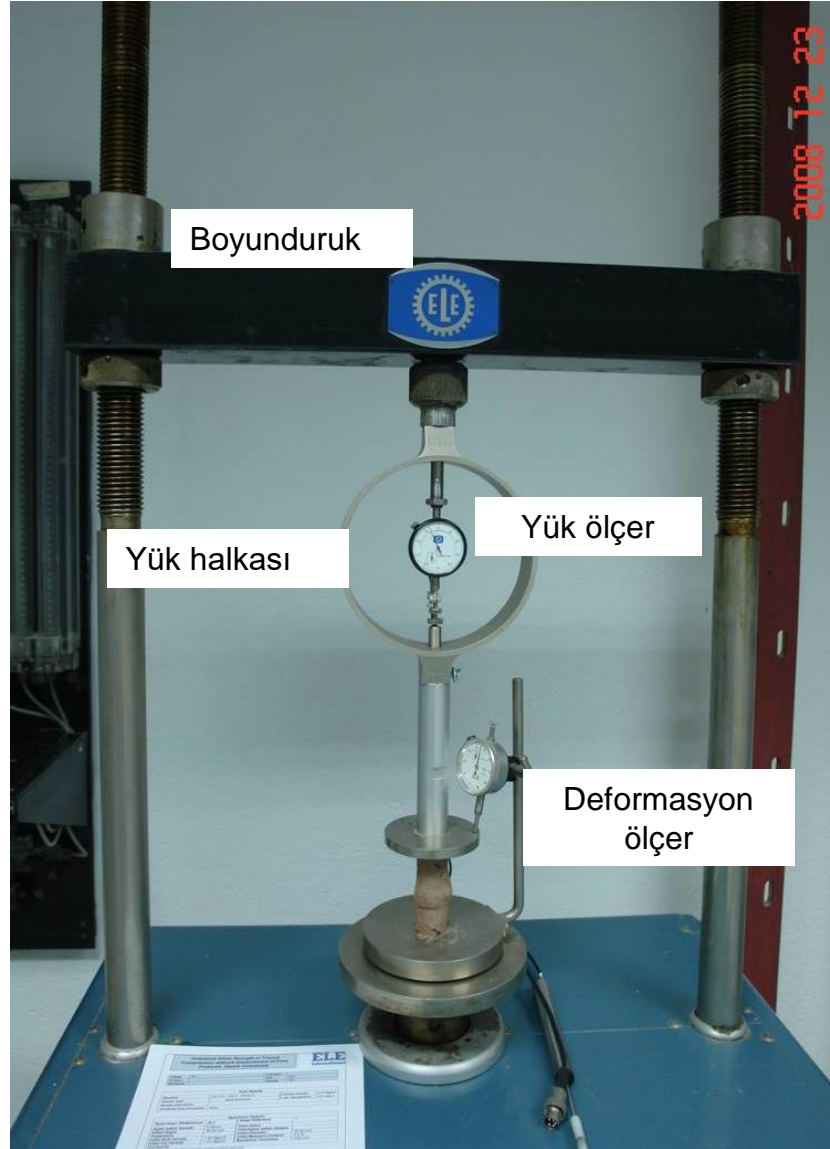


İnşaat öncesinde

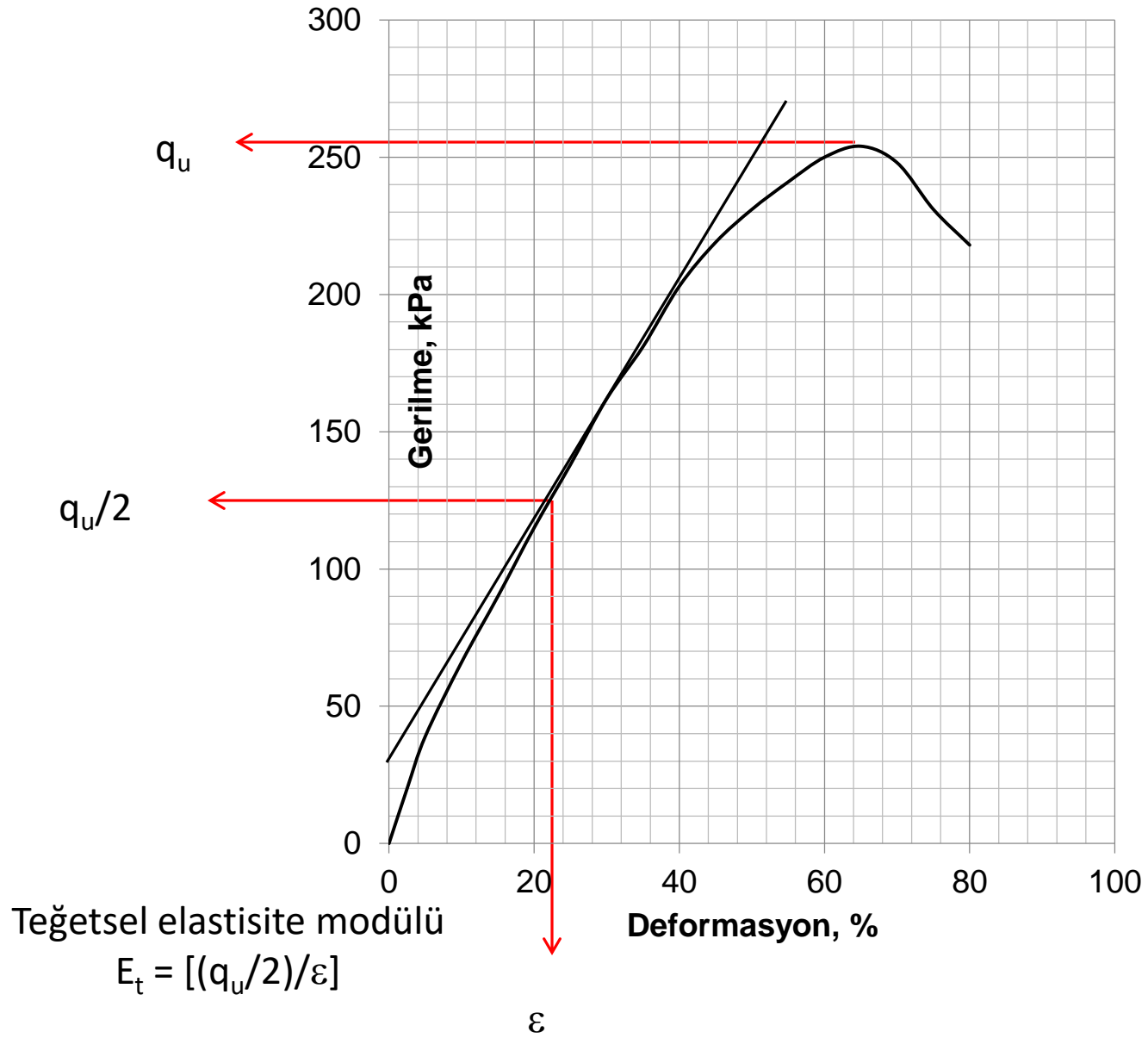


İnşaat esnasında ve sonrasında

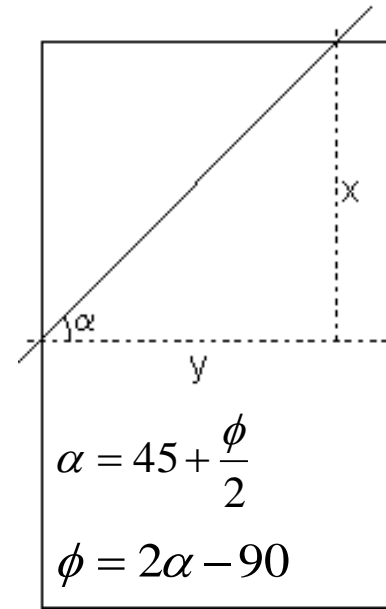
# TEK EKSENLİ BASINÇ (ASTM D2166-M16; TS CEN ISO 17892-7)



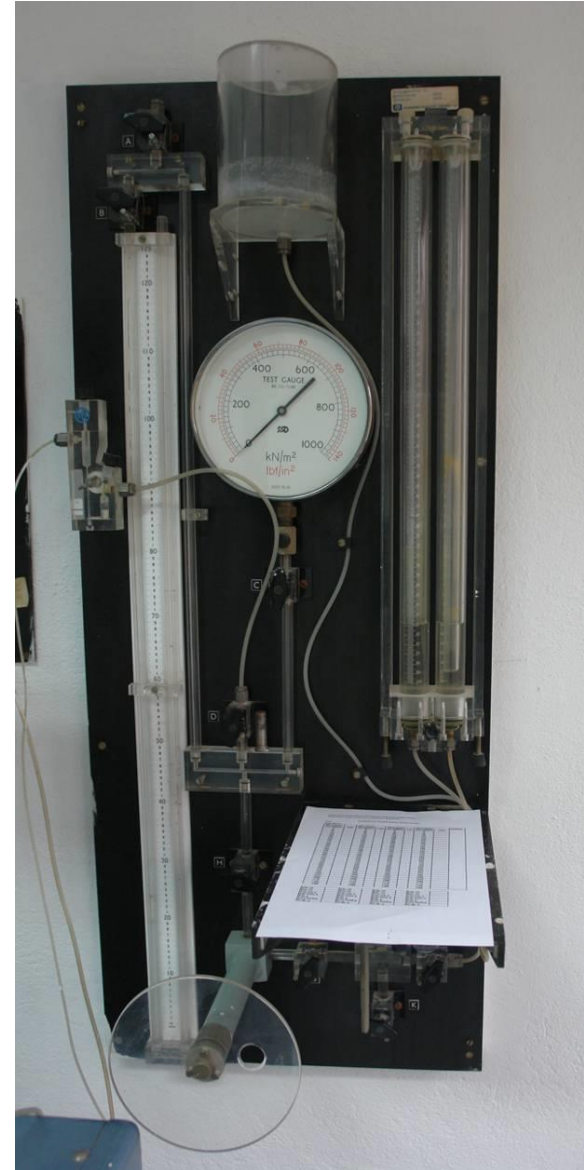
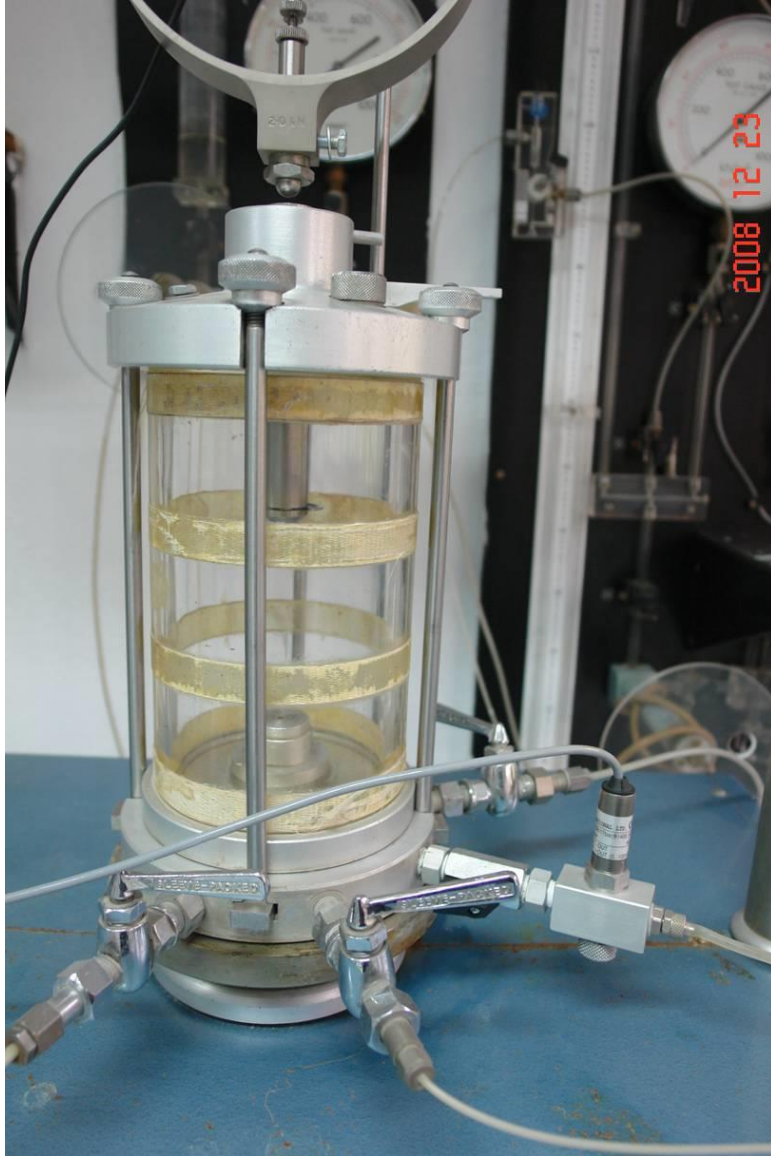
$\Delta L$ (mm) ( $\times 10^{-2}$ )	Yük Halkası Okuması ( $\times 10^{-2}$ )	F, kN ( $\times 10^{-2}$ )	Deformasyon $\varepsilon = \Delta L/l_0$ ( $\times 10^{-3}$ )	Gerilme $\sigma = F/A$ , kPa
0	0	0	0	0
20	30	2.01	2.5	20.14
40	45	3.96	5.0	39.68
80	68	6.61	10.0	66.11
120	85	9.03	15.0	90.35
160	100	11.50	20.0	115.00
200	111	13.81	25.0	138.10
240	120	16.22	30.0	162.20
280	128	18.12	35.0	181.12
320	135	20.33	40.0	203.35
360	142	21.95	45.0	219.58
400	148	23.11	50.0	231.14
440	153	24.11	55.0	241.18
480	157	25.03	60.0	250.36
520	161	25.42	65.0	254.22
560*	169	24.80	70.0	248.05
600	164	23.16	75.0	231.63
640	160	21.82	80.0	218.25



Kohezyon  
 $c \sim q_u/2$



# ÜÇ EKSENLİ UU DENEY (ASTM D2850-15; TSE CEN ISO/TS17892-8)



Hücre basıncı: 50 kPa		Hücre basıncı : 100 kPa		Hücre basıncı : 200 kPa	
Boy değişimi $\Delta L (\times 10^{-2})$	Yük halkası okuması( $\times 10^{-2}$ )	Boy değişimi $\Delta L (\times 10^{-2})$	Yük halkası okuması( $\times 10^{-2}$ )	Boy değişimi $\Delta L (\times 10^{-2})$	Yük halkası okuması( $\times 10^{-2}$ )
0	0	0	0	0	0
40	8	40	12.3	40	21.2
80	11	80	16.4	80	40.1
120	16.4	120	20.1	120	58.8
160	19.5	160	25.3	160	72.1
200	27.3	200	30.0	200	89.6
240	34.5	240	36.7	240	101.2
280	39.6	280	47.2	280	112.6
320	48.0	320	61.4	320	124.2
360	59.3	360	74.2	360	136.4
400*	70.4	400	88.4	400	150.1
440	66.2	440	101.6	440	162.5
480	63.3	480	122.8	480	178.4
		520*	134.1	520	192.6
		560	132.6	560	209.9
				600	220.4
				640	226.6
				680*	232.4
				720	225.5

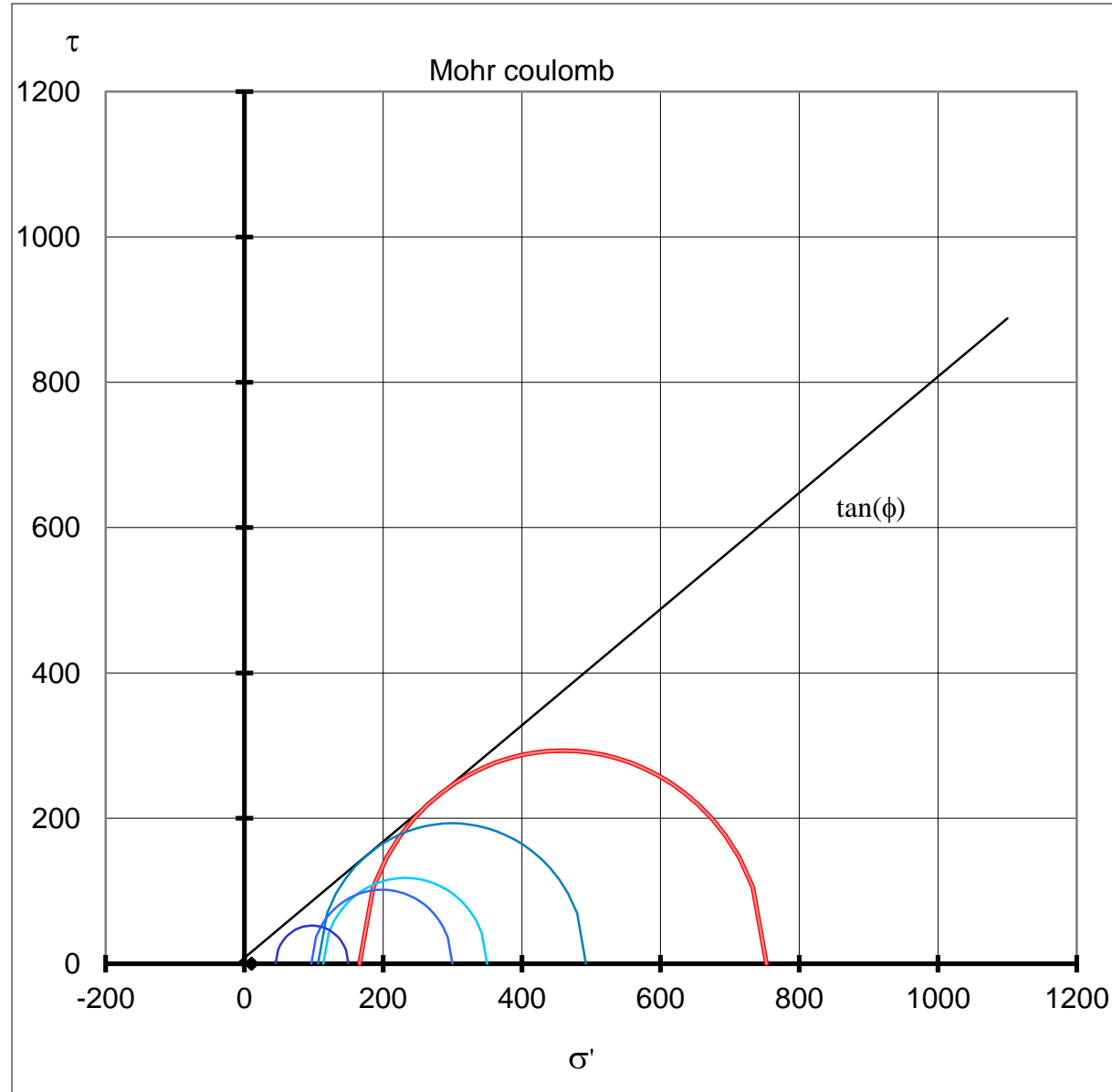
$$\sigma_1 - \sigma_3 = \frac{Y.H.O \times R.F.}{A_1}$$

$$\varepsilon = \frac{\Delta l}{l}$$

$$A_1 = \frac{A_0}{1 - \varepsilon}$$

\*Örnek yenilmiştir

$$r = \frac{\sigma_1 - \sigma_3}{2}$$



C=22 kPa  
 $\phi=36^\circ$

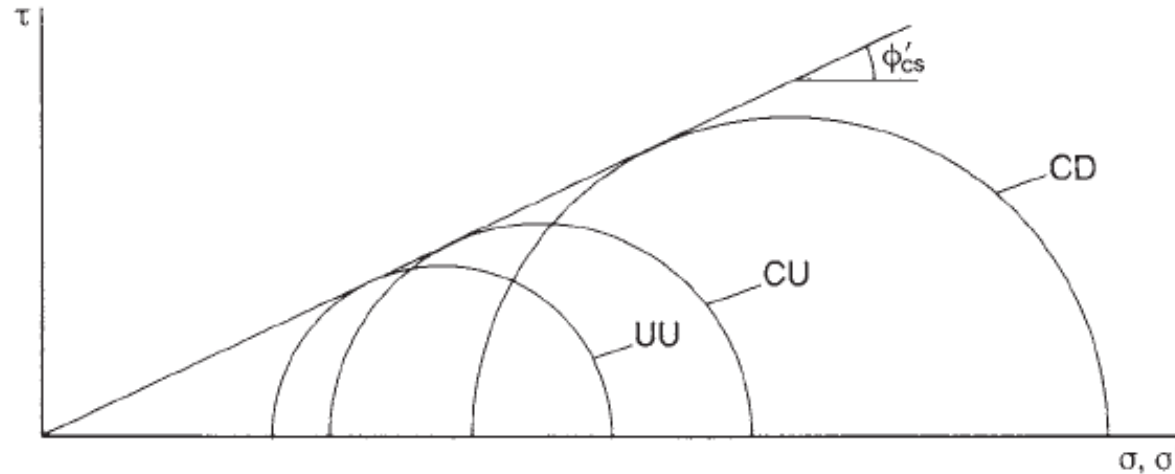
$$m = \frac{\sigma_1 + \sigma_3}{2}$$



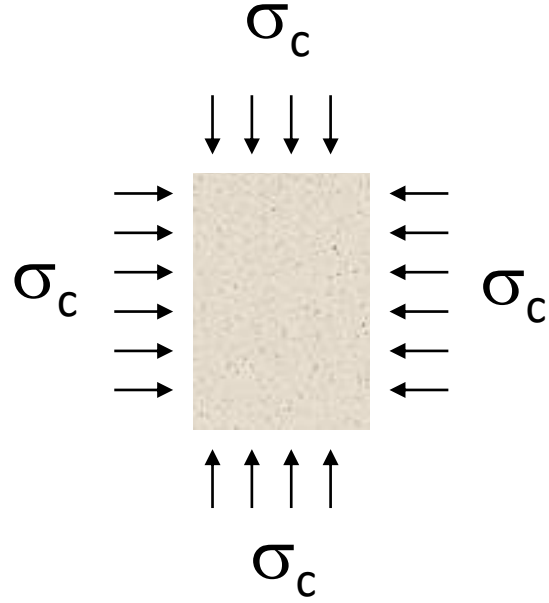
**Konsolidasyonsuz-Drenajsız (UU) Deney** : Örnek sabit hücre basıncı altında drenaja izin verilmeden yenilmeye uğrar.

**Konsolidasyonlu-Drenajsız (CU) Deney** : Sabit hücre basıncının yanında örnek konsolide edilir. Bu sırada yenilme olmaması için geri basınç uygulanır. Bu sayede efektif basınç dengelenmiş olur. Drenaj valfi açılarak boşluk suyu basıncının sıfırlanmasına izin verilir. Boşluk suyu basıncı yanında örnek içinde sıkışmış hava da uzaklaştırılmış olur. Deney sırasında valf kapatılarak boşluk suyu basıncının sadece sensör tarafından takip edilmesi sağlanır.

**Konsolidasyonlu-Drenajlı (CD) Deney** : Hücre basıncı ve konsolidasyon basıncına maruz bırakılan deney örneği drenaj valfi açılarak yenilmeye uğrar. Deney sırasında valf açık tutularak örnekten uzaklaşan/geri gelen suyun hacmi büretten takip edilir.



# Üç eksenli deney türleri



Hücre basıncı  $\sigma_c$

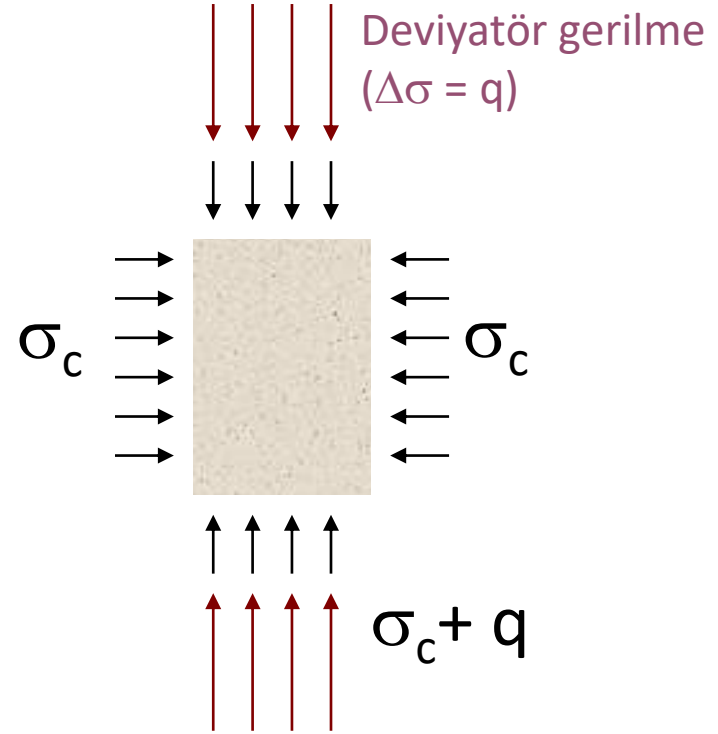
Drenaj valfi açık ?

evet

hayır

Konsolide  
(C)

Konsolidasyo  
nsuz (U)



Yükleme (loading)

Drenaj valfi açık ?

evet

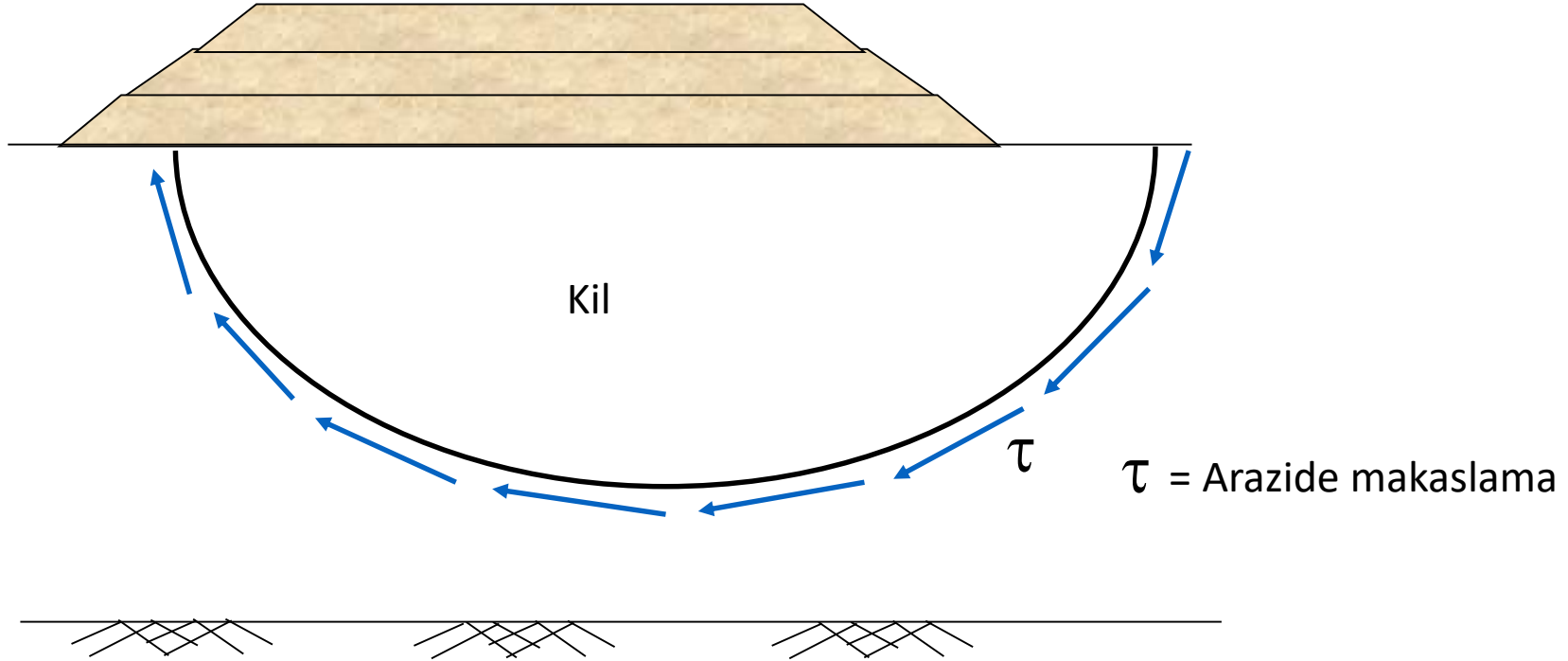
hayır

Drenajlı  
(D)

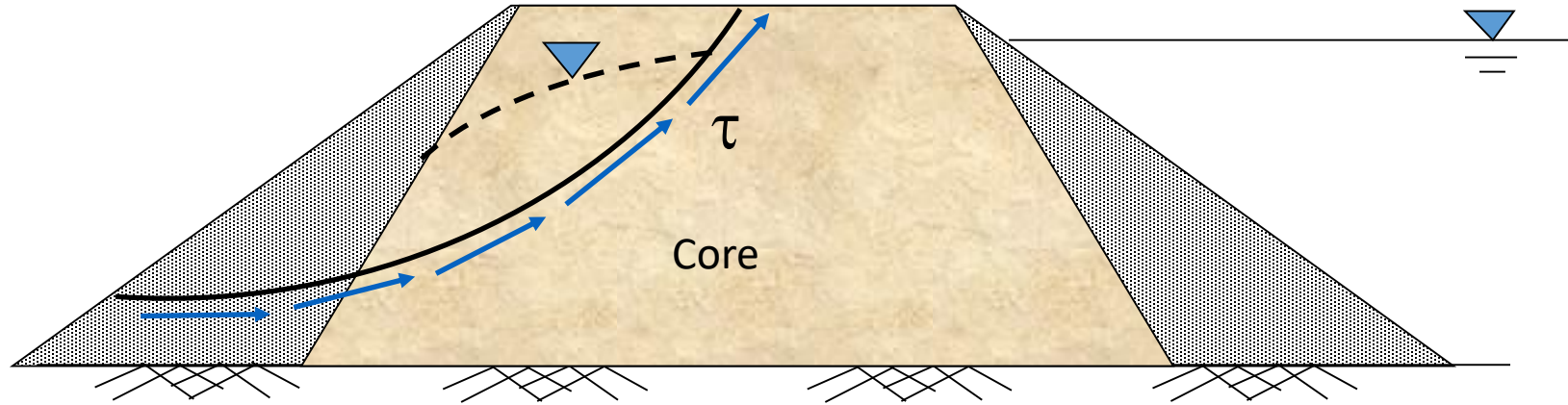
Drenajsız  
(U)

# ( Kondolidasyonlu-drenajlı)

1. Uzun süren inşaat, yumuşak kil üzerinde ve içinde



## 2. Kararlı akış bulunan toprak dolgu baraj



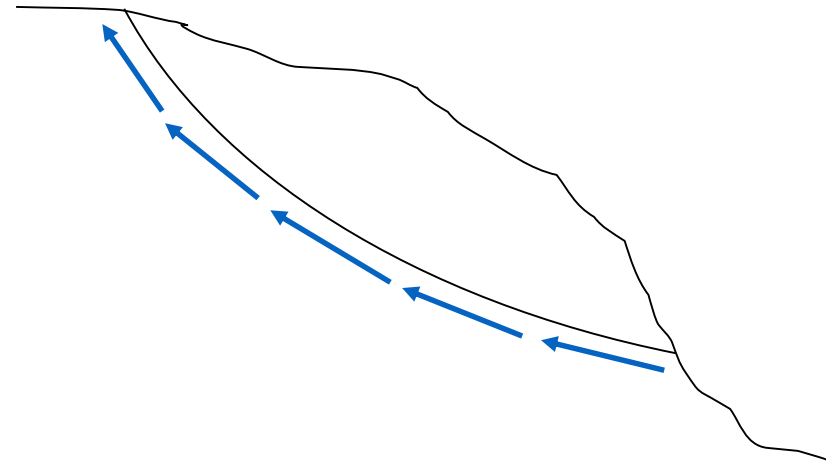
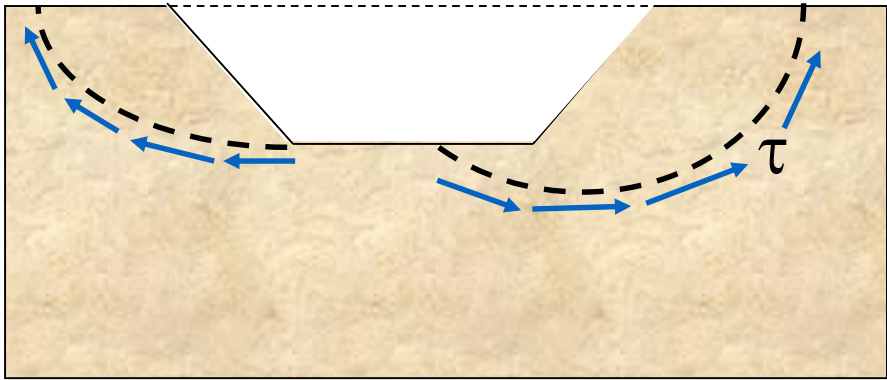
$\tau$  = Kil çekirdekte makaslama gerilmesi

**End of construction** – construction pore pressure usually reaches their maximum values when the embankment reaches maximum height

**Steady-state seepage** – after the reservoir has been filled for a long time, pore pressures are determined by steady state seepage conditions and may be estimated from a flow net where gravitational flow conditions govern.

# Some practical applications of CD analysis for clays

## 3. Excavation or natural slope in clay



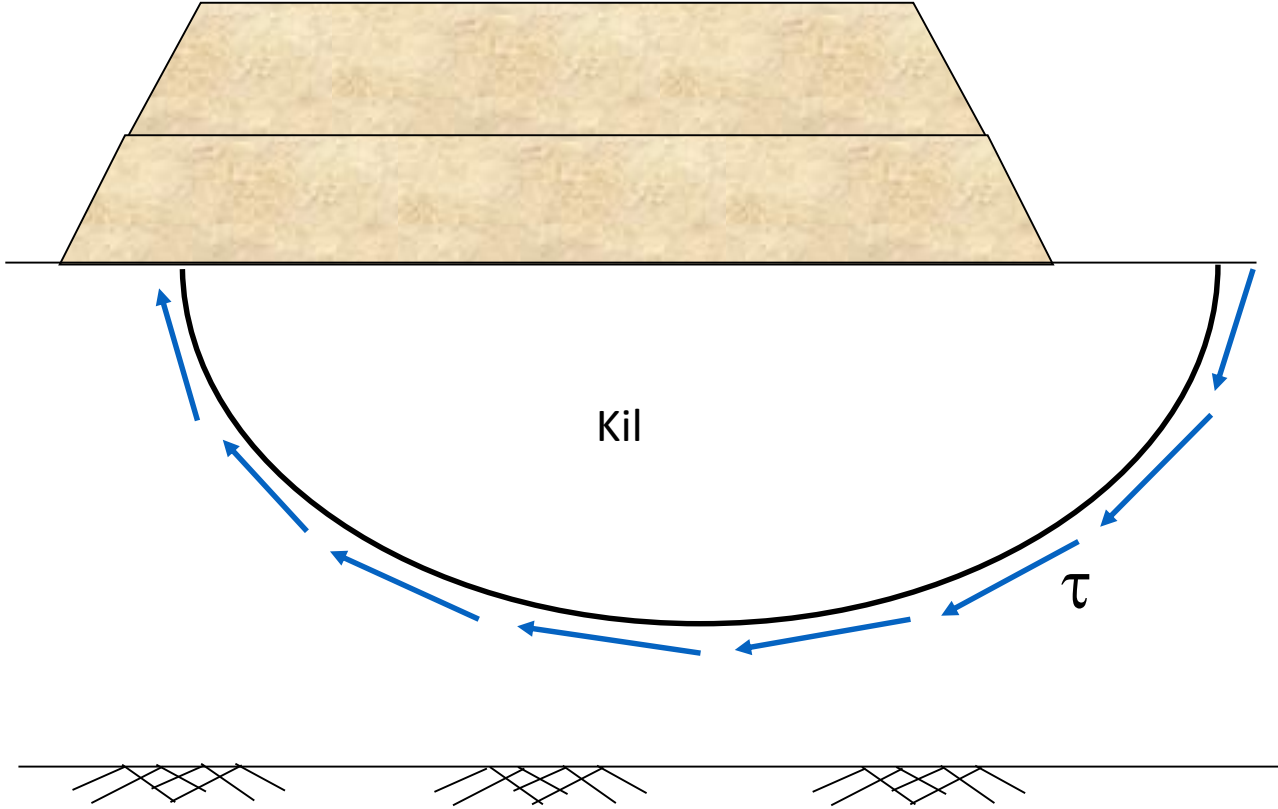
$\tau$  = In situ drained shear strength

Note: CD test simulates the long term condition in the field. Thus,  $c_d$  and  $\phi_d$  should be used to evaluate the long term behavior of soils

# Konsolidasyonlu-Drenajsız (CU)

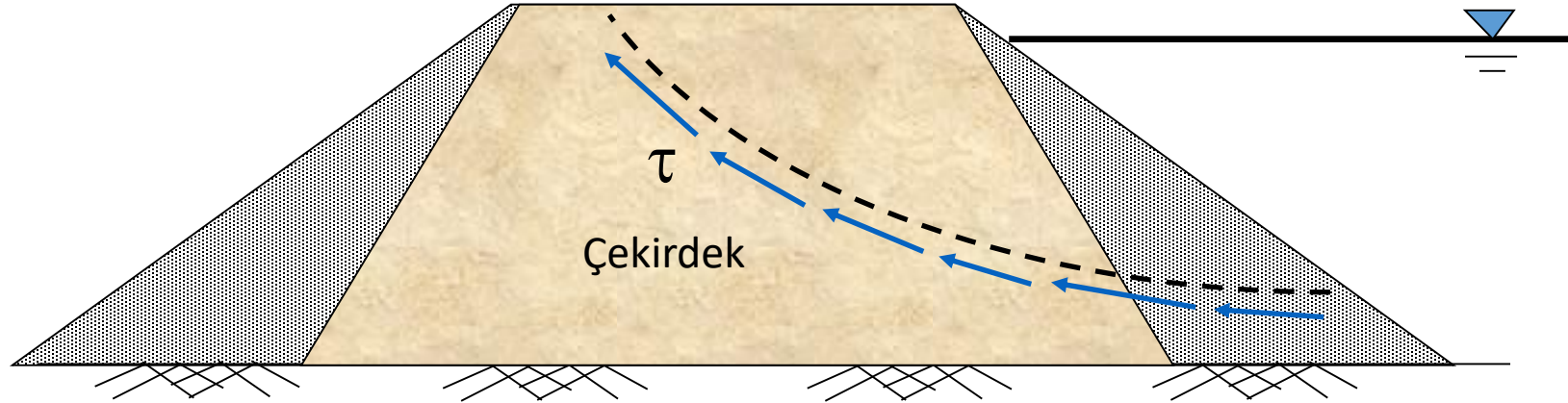
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## 1. Kısa süren inşaat



# Some practical applications of CU analysis for clays

## 2. Rapid drawdown behind an earth dam

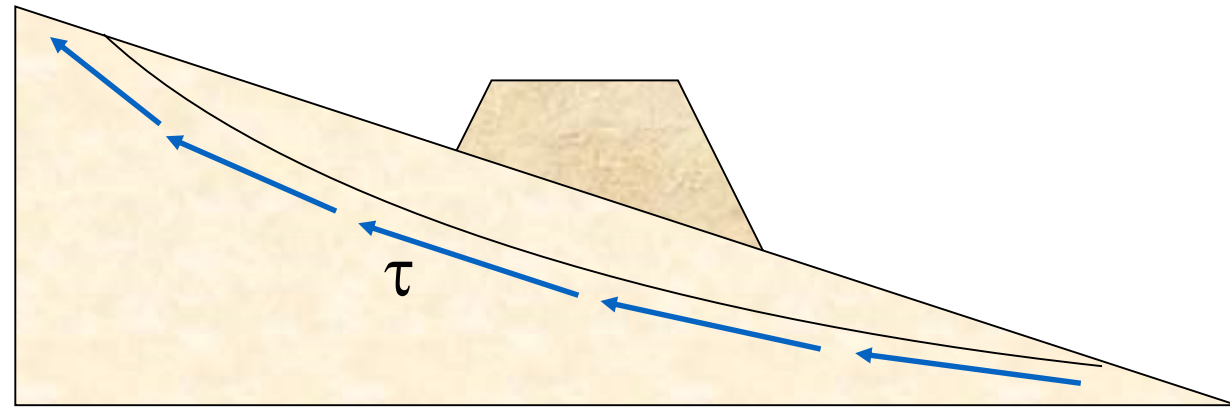


**Rapid draw down** – the upstream slope stability may be critical for the rapid draw down condition where the water in the reservoir can drop drastically.

# Some practical applications of CU analysis for clays

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## 3. Rapid construction of an embankment on a natural slope



$\tau$  = In situ undrained shear strength

Note: Total stress parameters from CU test ( $c_{cu}$  and  $\phi_{cu}$ ) can be used for stability problems where,  
Soil have become fully consolidated and are at equilibrium with the existing stress state; Then for some reason additional stresses are applied quickly with no drainage occurring



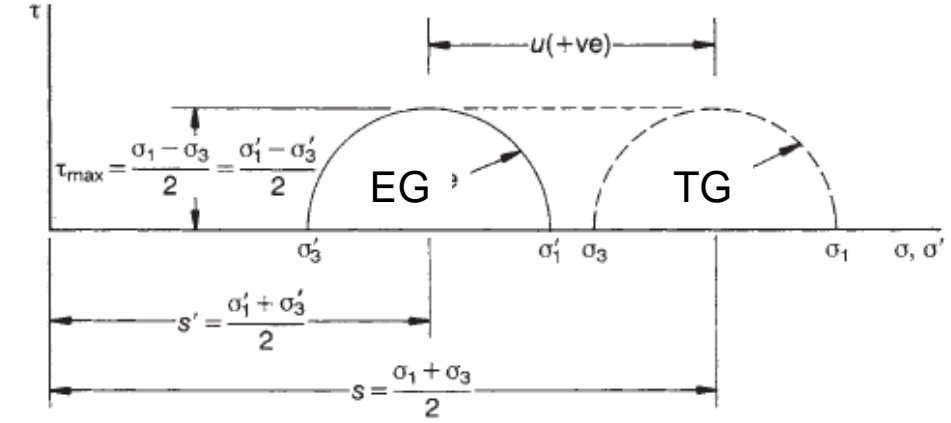
## BOŞLUK SUYU BASINCI (U) PARAMETRELERİ

$$\Delta u = [B \Delta \sigma_3 + A (\Delta \sigma_1 - \Delta \sigma_3)]$$

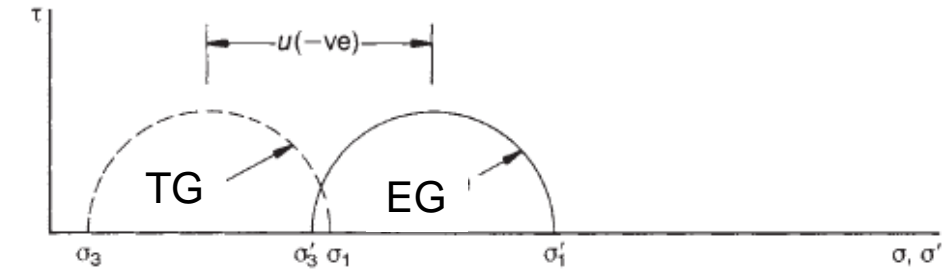
Doygun zeminlerde B=1

$$A = (\Delta u / \Delta \sigma_d)$$

Kil türü	A
Çok hassas	0.75 - 1.5
Normal konsolide	0.5 - 1
Kumlu	0.25 - 0.75
Az aşırı konsolide	0.0 - 0.5
Çakıllı	- 0.25 ile 0.25
Yüksek derece aşırı konsolide	-0.5 ile 0.0



(a)

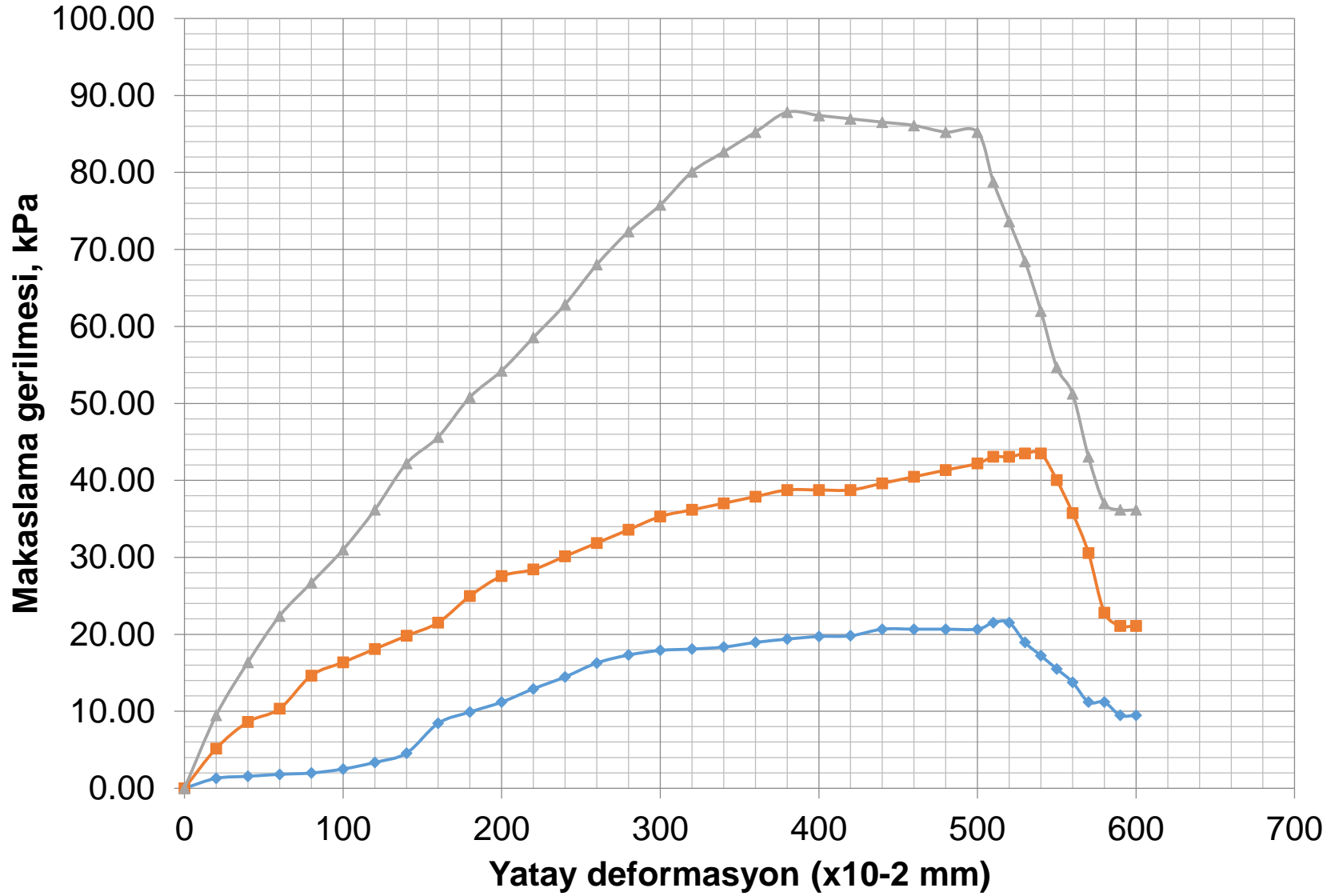


(b)

Üç eksenli deneyde (a) pozitif boşluk suyu basıncı, (b) negatif boşluk suyu basıncı

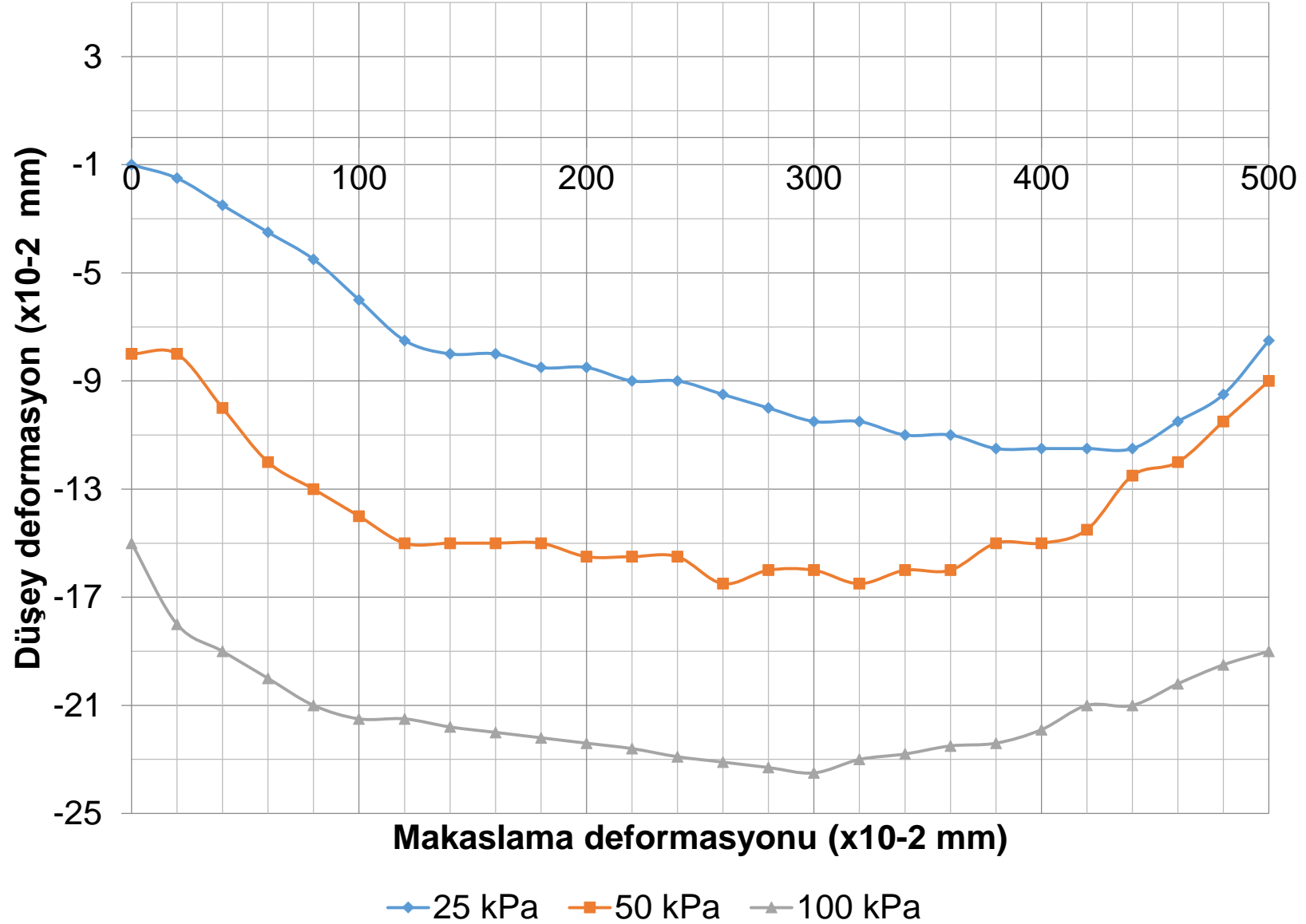
# DİREKT MAKASLAMA DENEYİ (ASTM D3080; TSE CEN ISO/TS 17892-10)





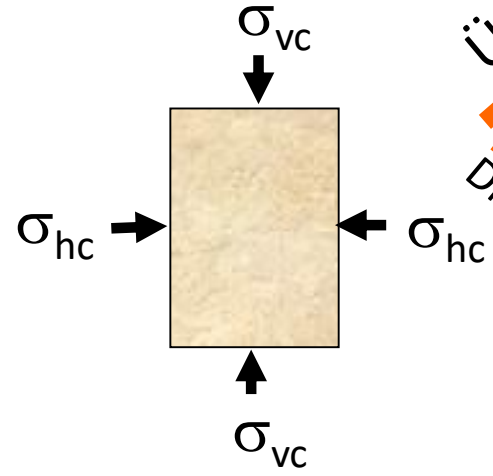
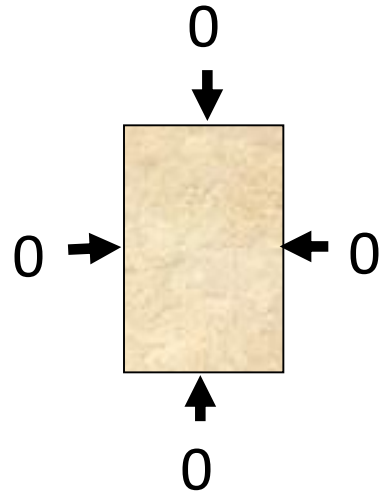
—◆— 25 kPa —■— 50 kPa —▲— 100 kPa

Makaslama deneyinde gerilme-deformasyon iliřkisi

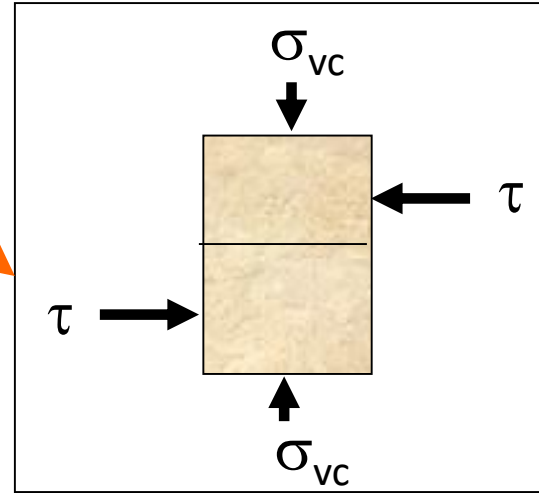
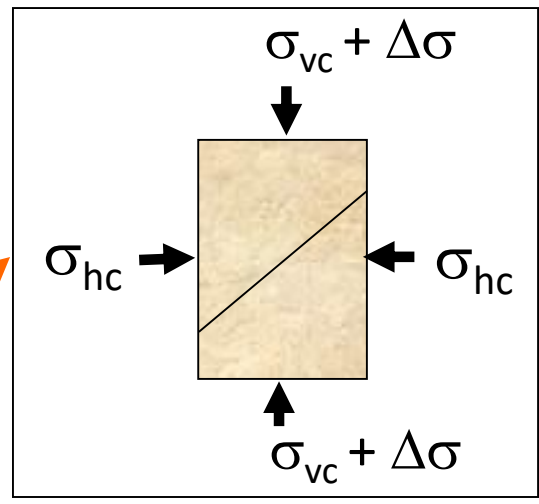


Makaslama deneyinde makaslama-düşey deformasyon ilişkisi

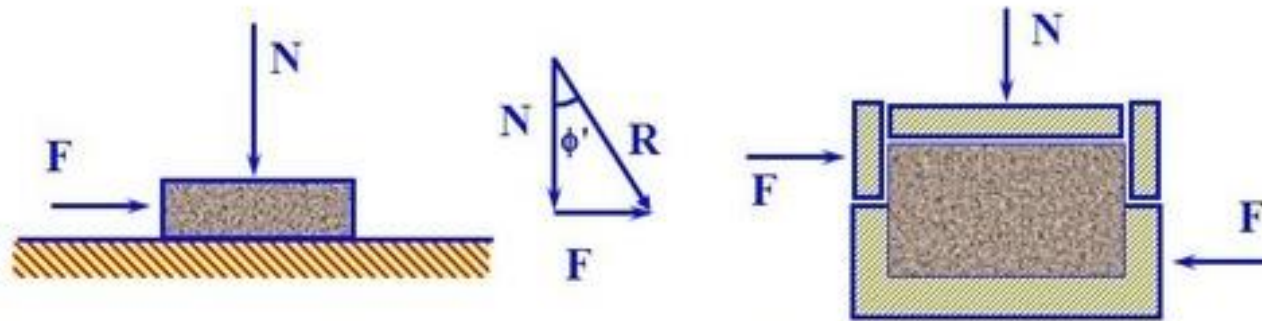
Arazi koşullarının laboratuvarda benzetilmesi



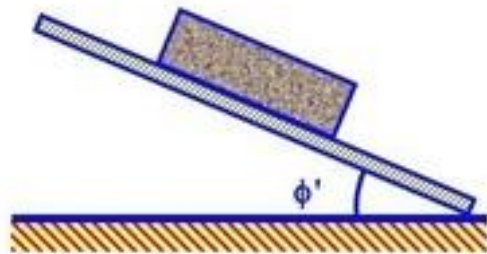
Üç eksenli  
Direkt makaslama



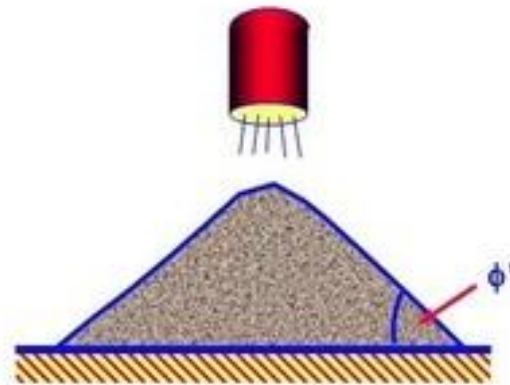
## Soil Strength: Angle of Internal Friction $\phi'$



$\phi'$ : Angle of internal friction;  $\mu$ : coefficient of friction  
 $\tan \phi' = \mu = F/N$



$\phi'$ : Angle of plank when block slides



$\phi'$ : Angle of repose of sand heap

# SOIL PARTICLE COHESION

