Geotechnical Engineering–II

BSc Civil Engineering – 5th Semester

Lab # 3

by

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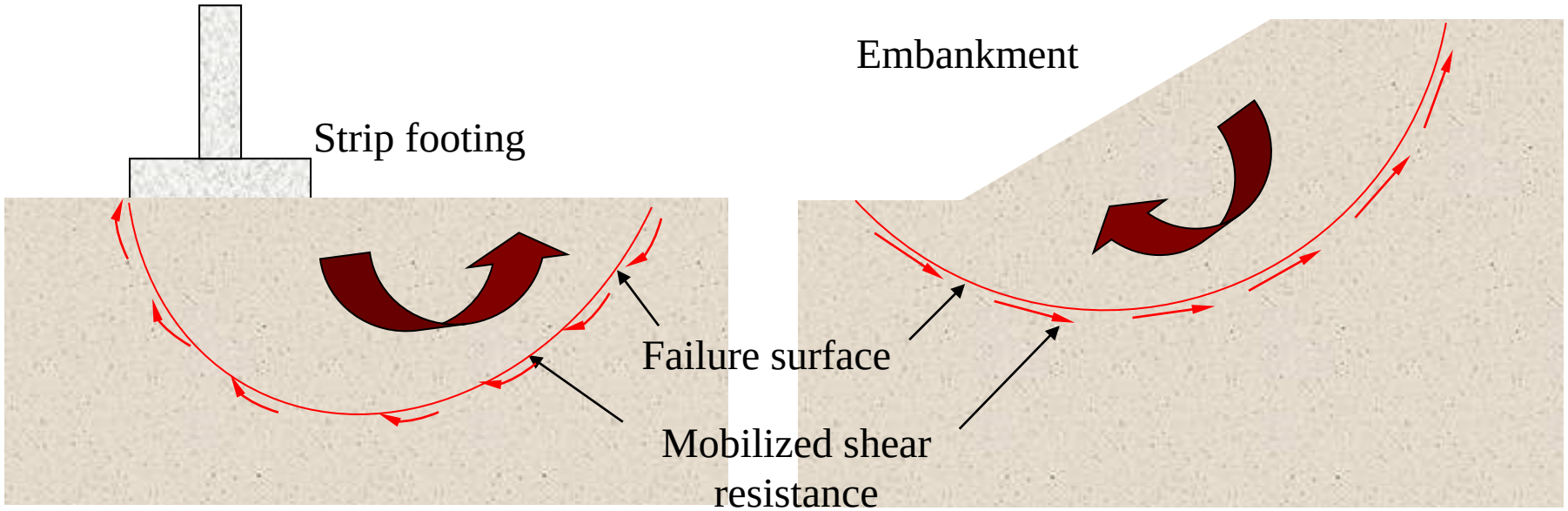
Lecture Handouts: https://groups.google.com/forum/#!forum/geotech-ii

SOIL STRENGTH

SOIL

- Mostly loaded in *compression*
- But fails mostly in *shear*



SHEAR STRENGTH OF SOIL

Mohr-Coulomb Failure Envelope

Simplest approximation of soil shear strength

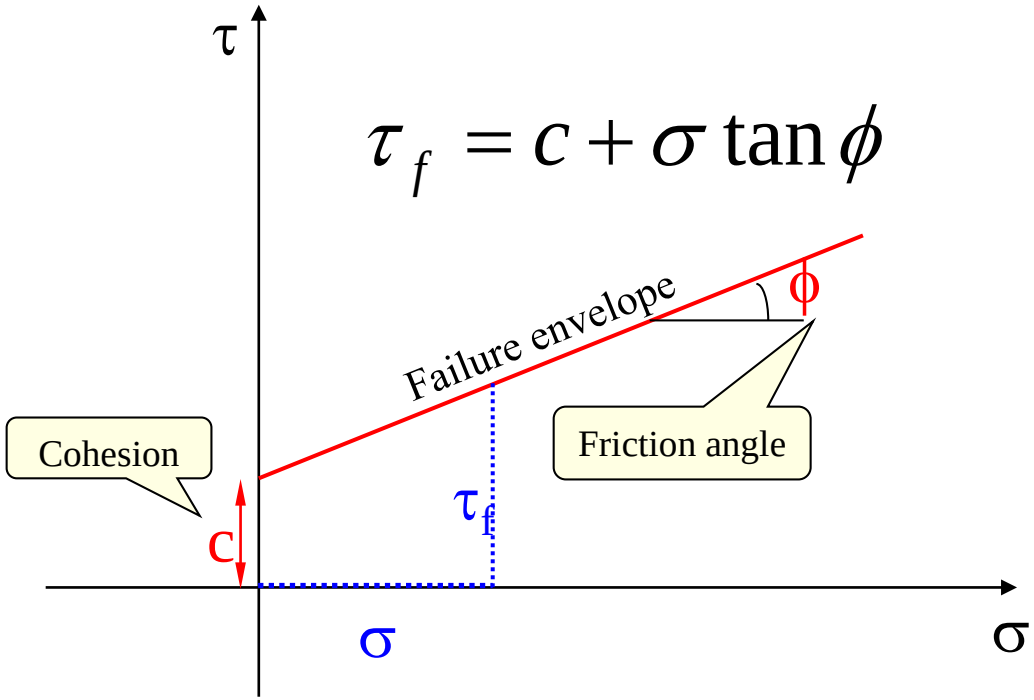
$$\tau_f = c + \sigma \tan\phi$$

τ_f = shear strength

c = cohesion

σ = normal stress

φ = angle of internal friction



SHEAR STRENGTH
- LAB DETERMINATION -

1. Direct shear test
2. Unconfined compression test
3. Triaxial compression test

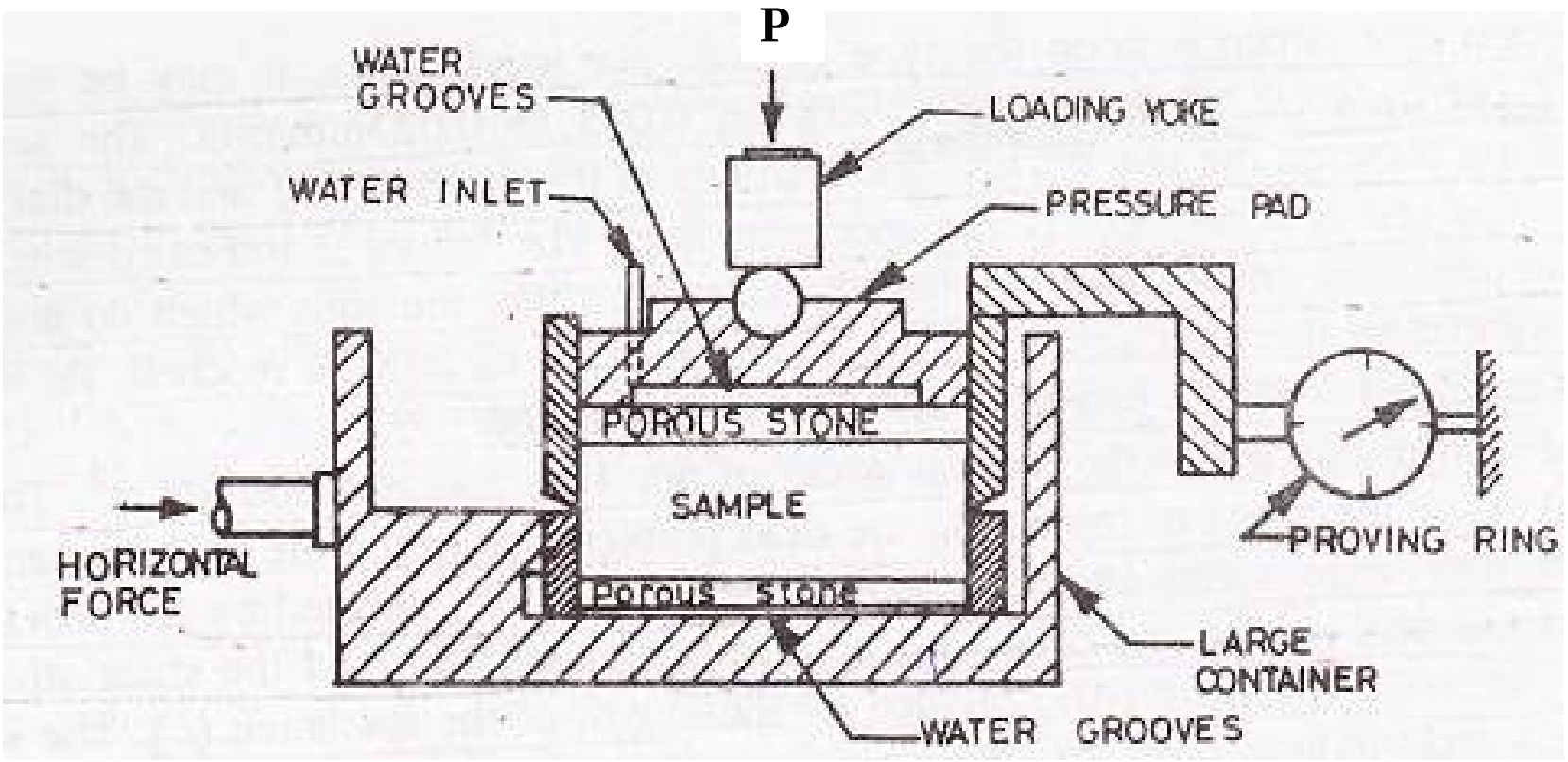
Direct Shear Test

- Relatively simpler
- Quick
- Mostly used for granular soils

DIRECT SHEAR TEST

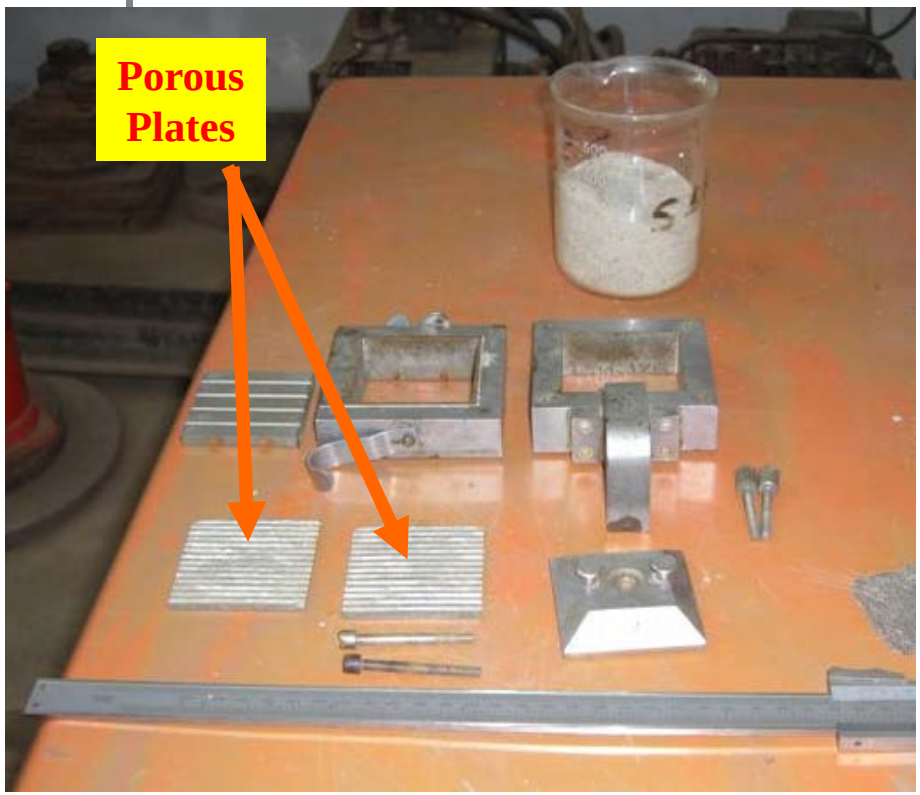
- Schematic Illustration -

$$\tau_f = c + \sigma \tan\phi$$



DIRECT SHEAR TEST

- Specimen Preparation -

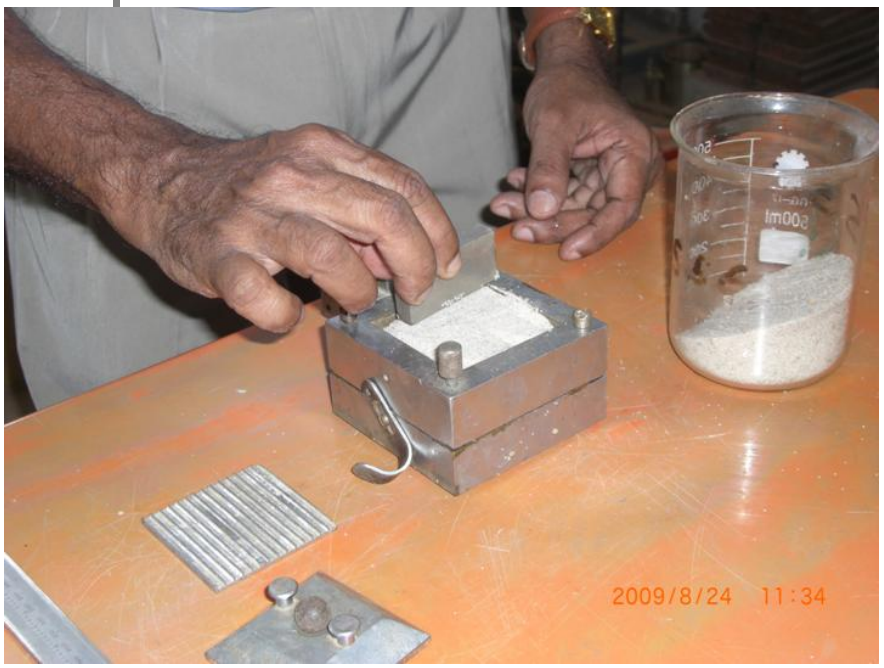


Components of Shear Box

Preparation of Sand specimen

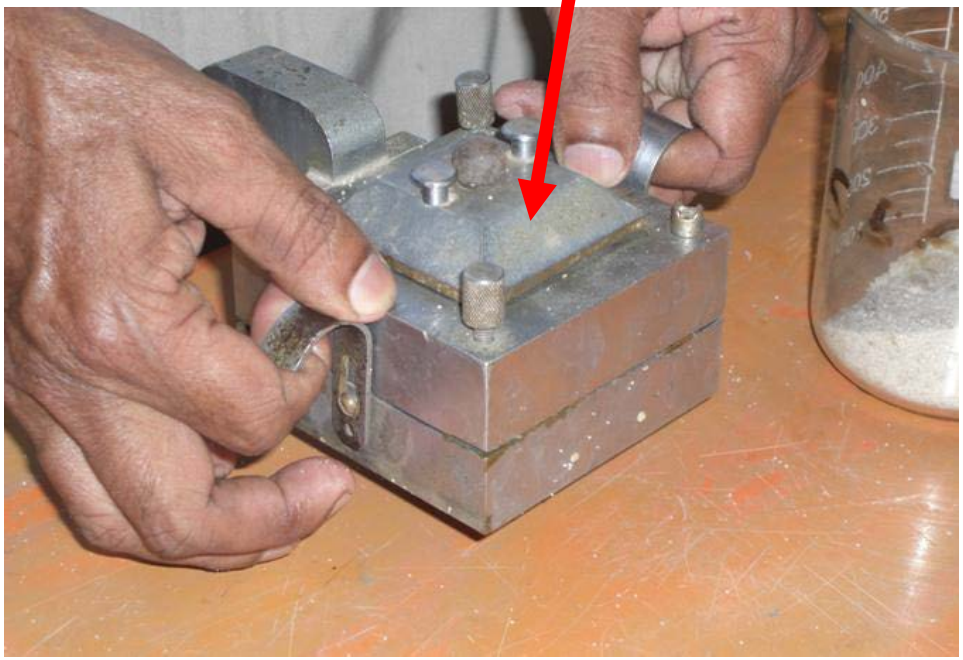
DIRECT SHEAR TEST

- Specimen Preparation -



Leveling the top surface of specimen

Pressure plate

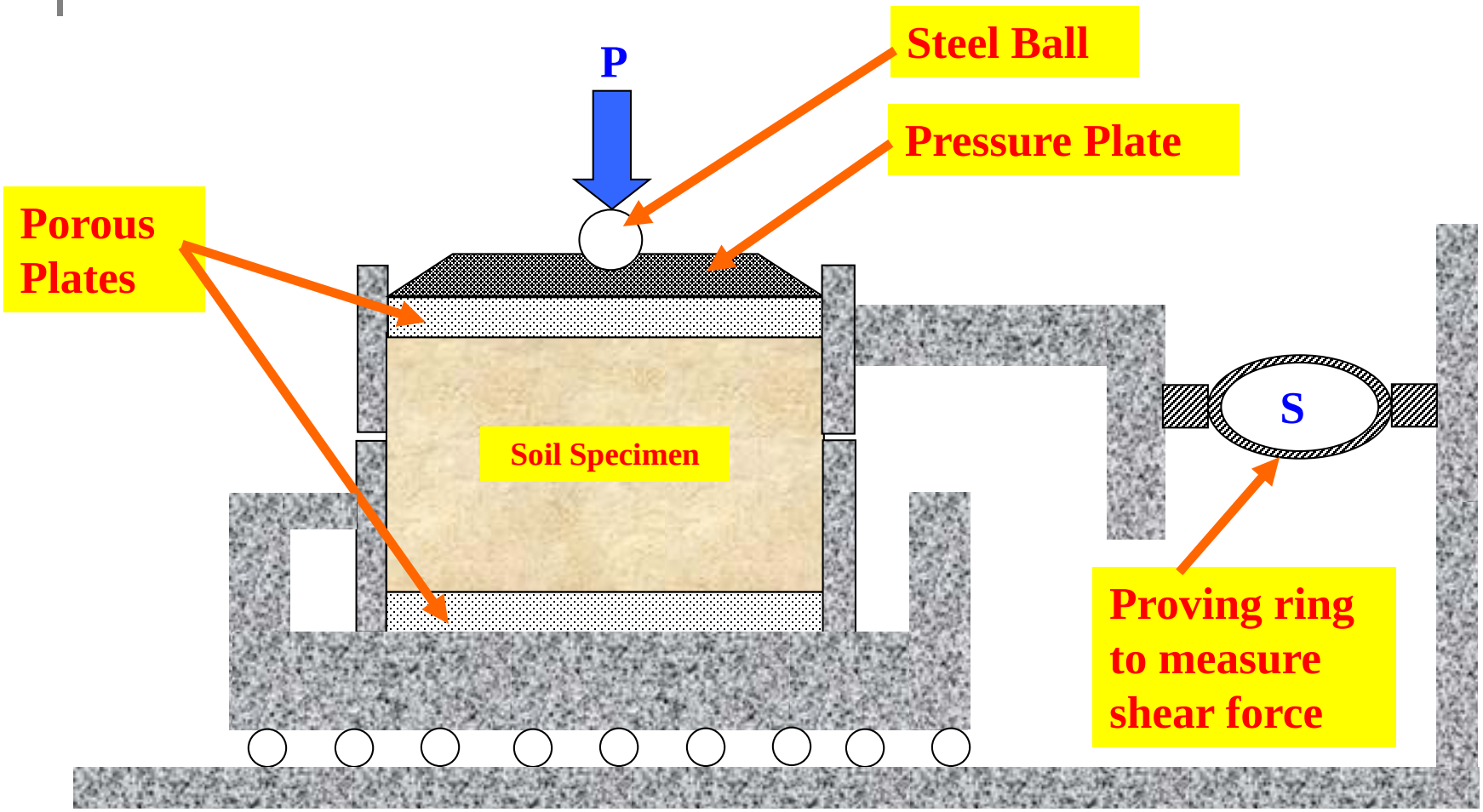


Specimen preparation completed

DIRECT SHEAR TEST

- Test Procedure -

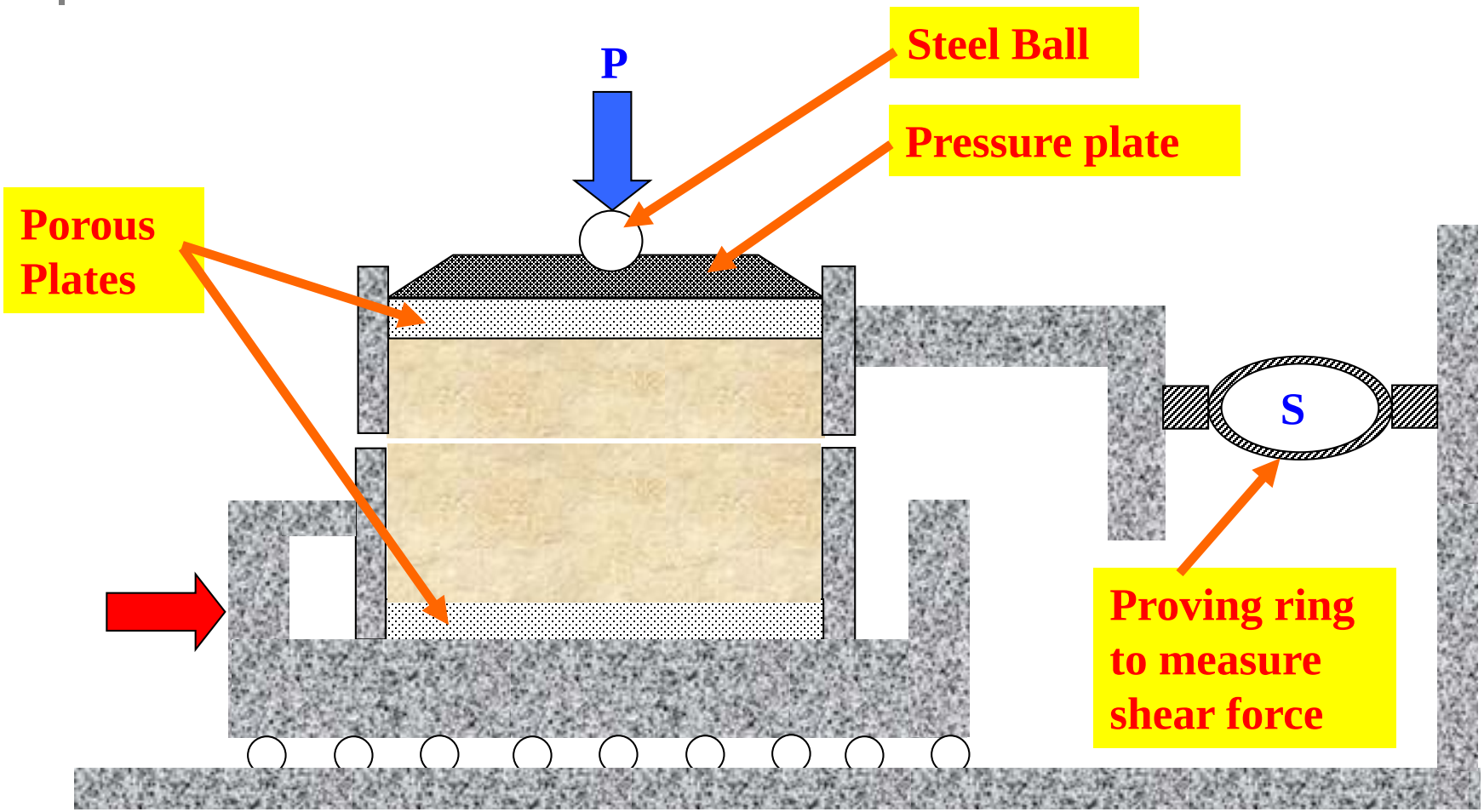
Step 1: Apply a vertical load to the specimen and wait for consolidation



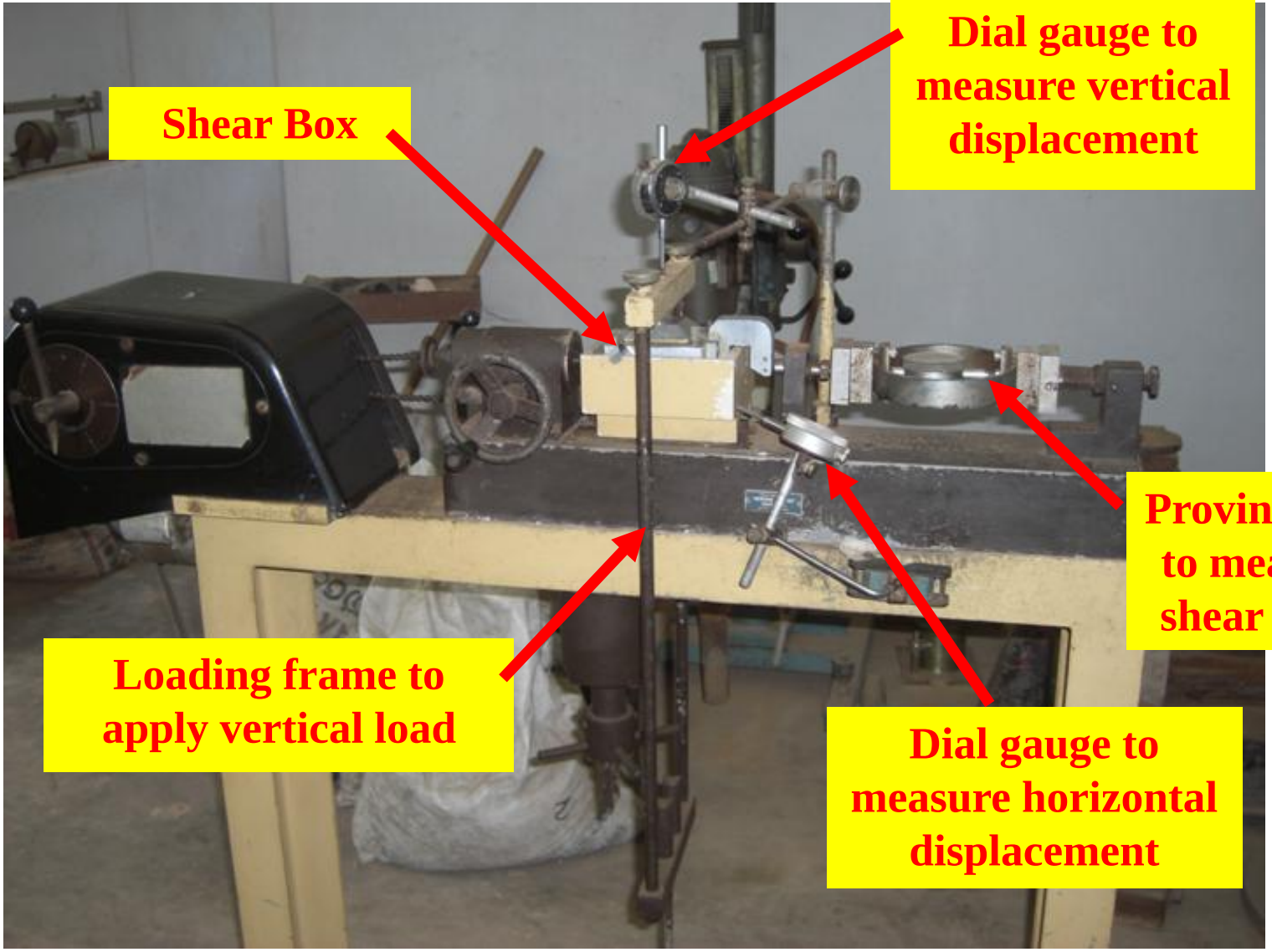
DIRECT SHEAR TEST

- Test Procedure -

Step 2: Lower box is subjected to a horizontal displacement at a constant rate



DIRECT SHEAR TEST



DIRECT SHEAR TEST

- Calculations -

$$\tau_f = c + \sigma \tan\phi$$

$$\sigma = \text{Normal stress} = \frac{\text{Normal force (P)}}{\text{Cross-sectional Area of sample}}$$

$$\tau = \text{Shear stress} = \frac{\text{Shear resistance developed at the sliding surface (F)}}{\text{Cross-sectional Area of sample}}$$

Cross-sectional area of the sample changes with the horizontal displacement

$$A_C = A_o - B.\Delta h$$

A_c = Corrected Area

A_o = Original Area

B = Width

Δh = Sample Deformation

DIRECT SHEAR TEST

- Calculations -

Sample # 2

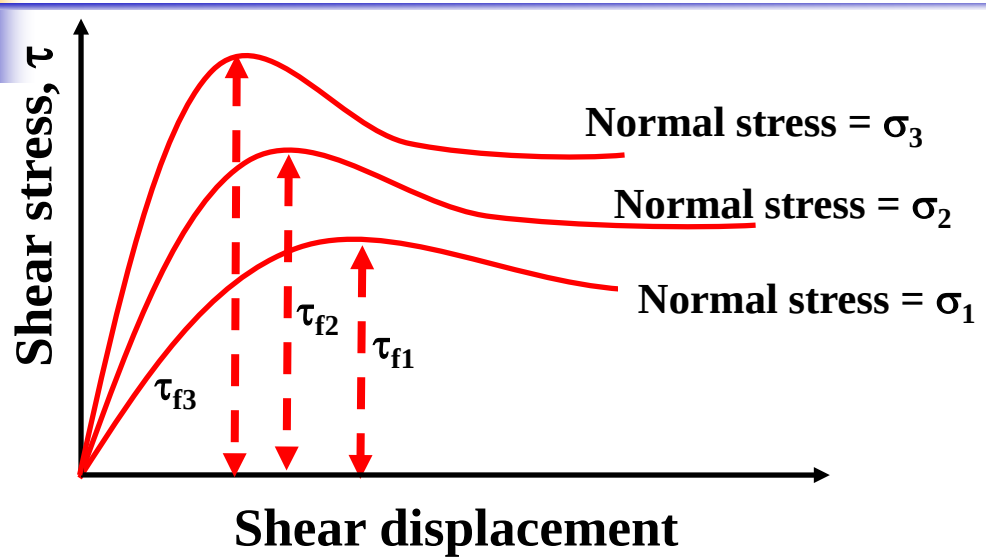
Sample Calculations

DDG constant	=	0.01 mm/div
Proving Ring constant	=	0.8 lb/div
Weight of Hanger	=	8 lb 15 ounce
	=	8.94 lb
Normal Load	=	20 lb
Total Normal Load	=	28.94 lb

Sample #	Normal Load, N	Horizontal D/R	Horizontal Displacement, ΔH Col#3×L.C	Corrected Area, Ac =A_0-bΔH	Load Dial Reading	Horizontal Shear Force, F Col#6×PRC	Normal Stress, σ_n=N/A_C	Shear Stress, T=F/A_C
	(lb)		(mm)	(mm^2)		(lb)	(kN/m^2)	(kN/m^2)
1	2	3	4	5	6	7	8	9
2	28.94	0	0.0	36.00	0.0	0.0	35.77	0.00
	28.94	20	0.2	35.88	17.0	13.6	35.89	16.87
	28.94	40	0.4	35.76	21.0	16.8	36.01	20.91
	28.94	60	0.6	35.64	23.0	18.4	36.13	22.97

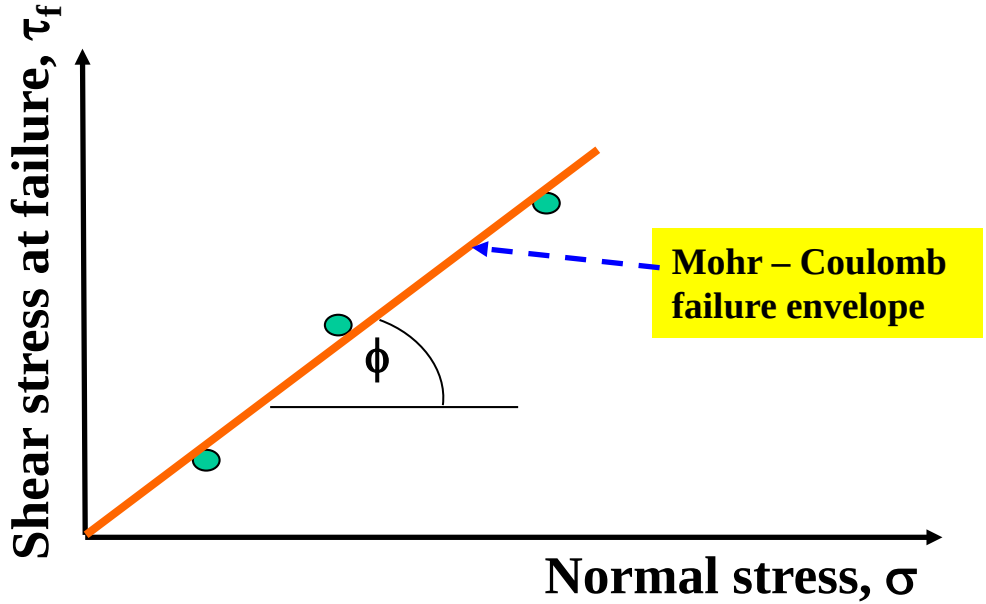
DIRECT SHEAR TEST

- Analysis of Results -



$$\tau_f = c + \sigma \tan\phi$$

How to determine shear strength parameters ***c*** and ϕ ?



CONCLUDED