

An overview of the University College Dublin Hollow Cylinder Apparatus

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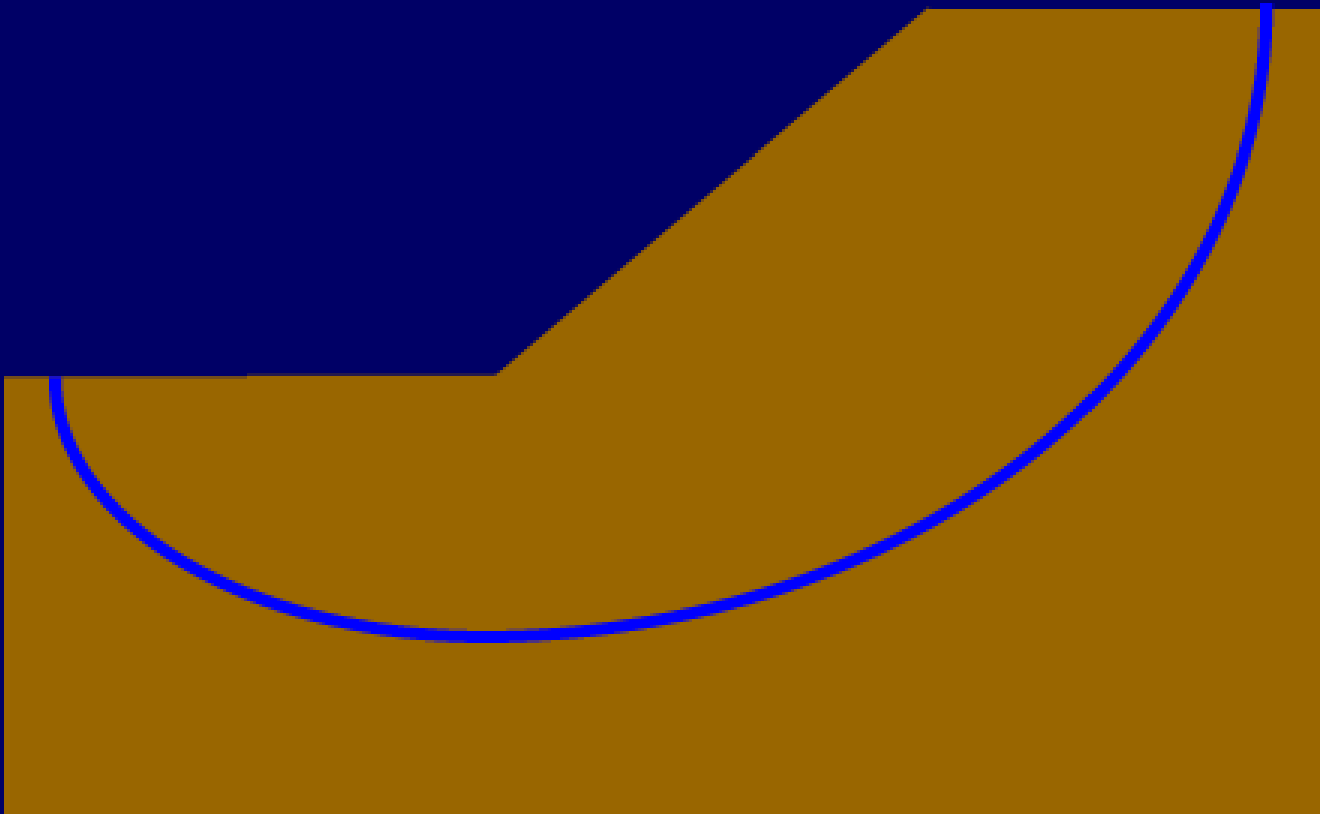
Format of Presentation

- An example of the rotation of the principal stresses
- HCA Sample, stresses and strains
- Stress Path Testing
- UCDHCA and Instrumentation
- Use of HCA test results

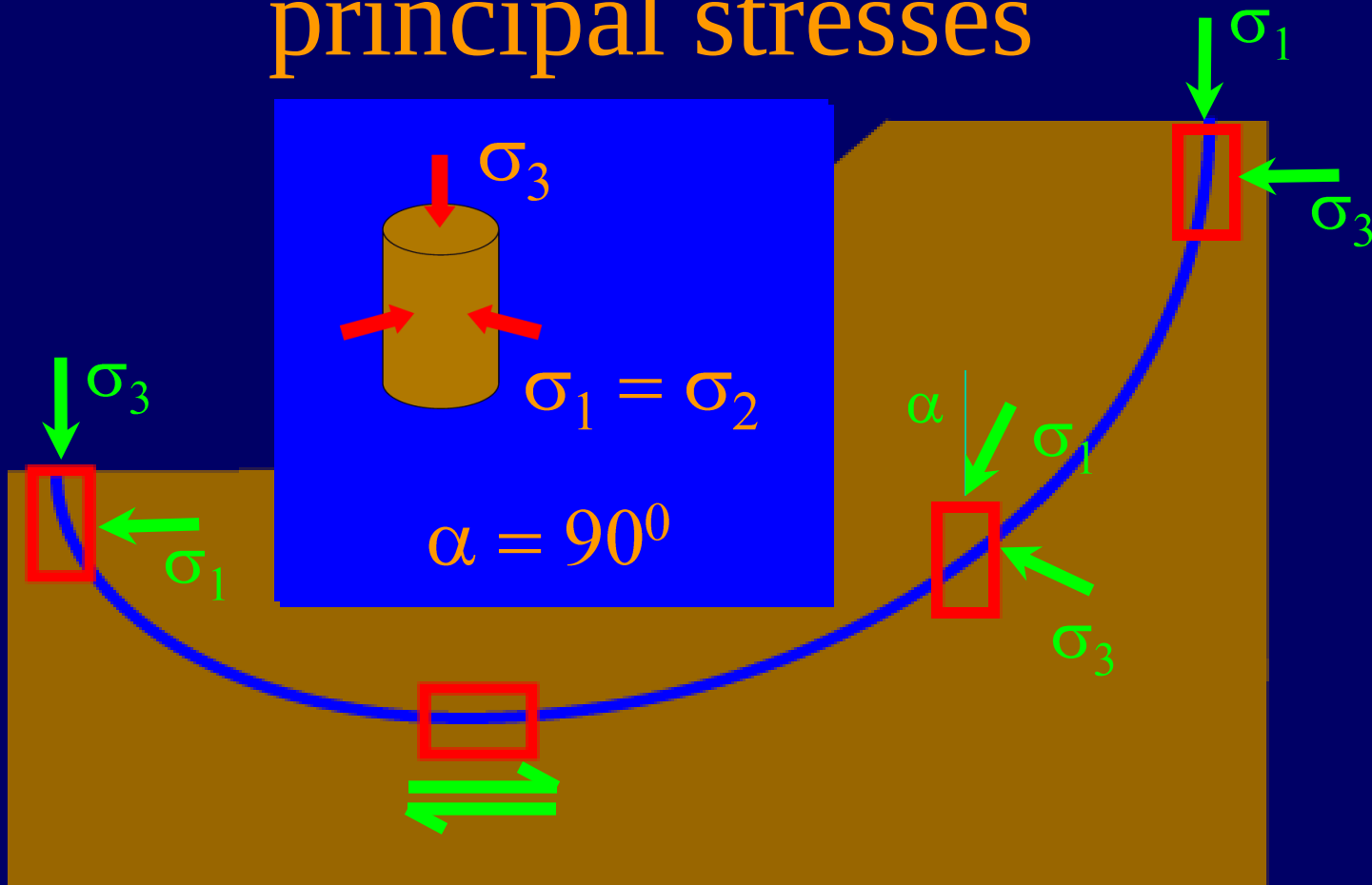
An example of the rotation of the principal stresses



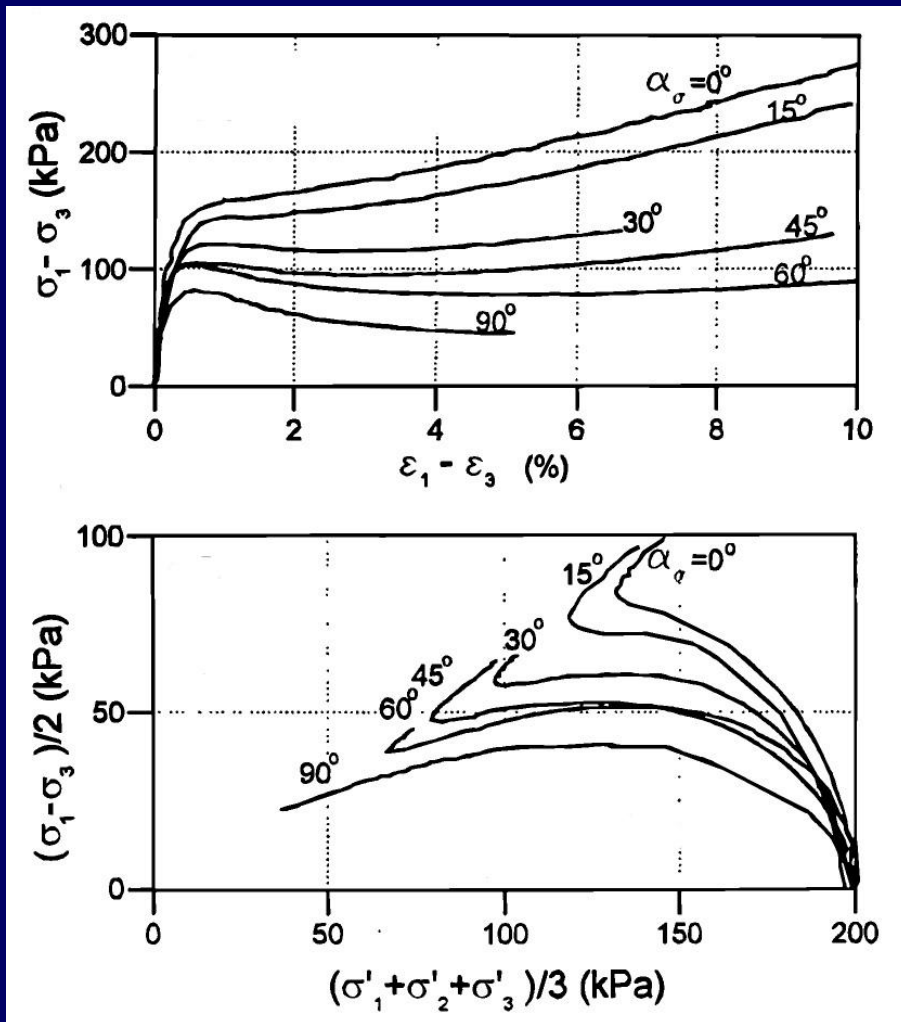
An example of the rotation of the principal stresses



An example of the rotation of the principal stresses



Effect of Principal Stress Rotation



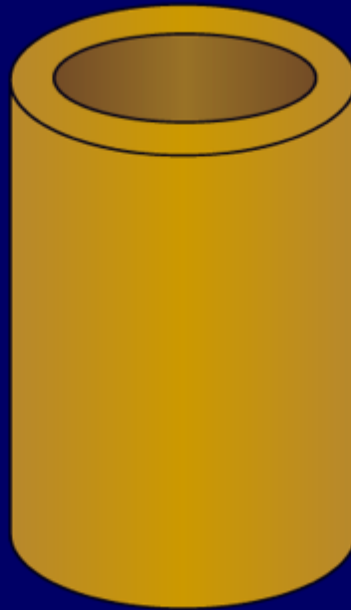
Mean Stress = 200 kPa

$\sigma_3 = \sigma_2$

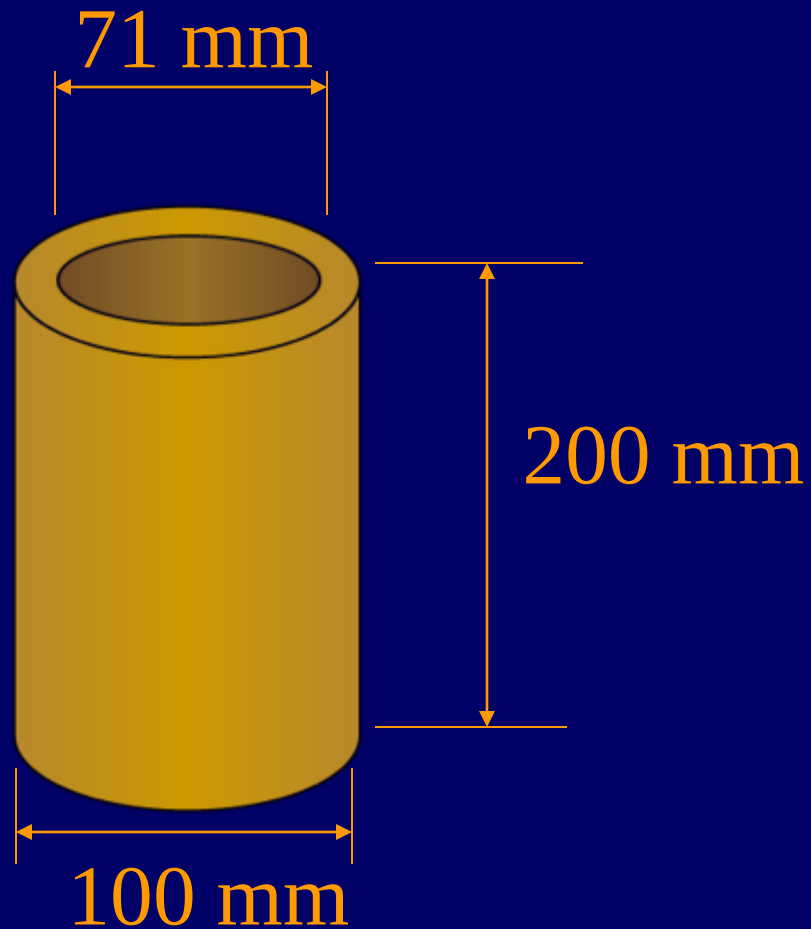
$Dr_c = 30 \%$

From Uthayakumar & Vaid
(1998), UBC

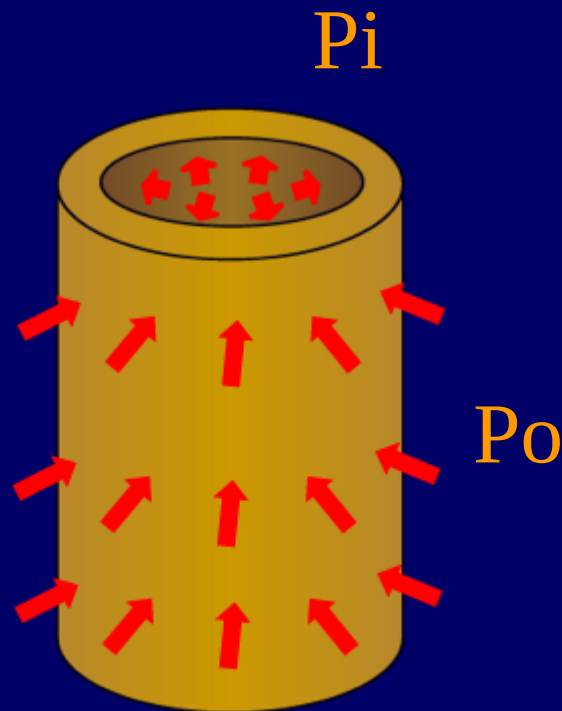
UCDHCA Sample



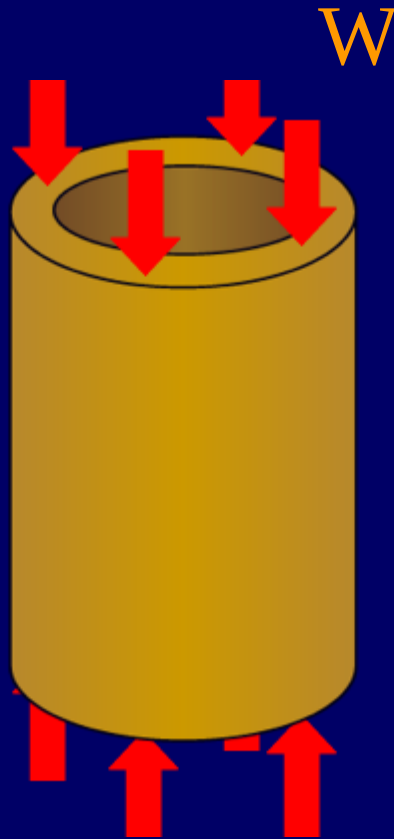
UCDHCA Sample



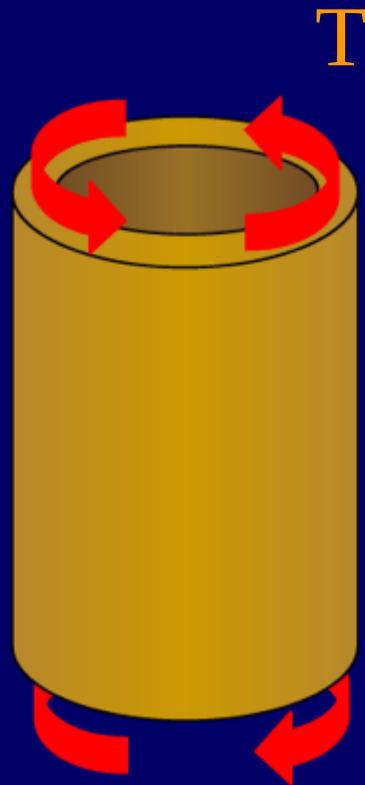
Applied Pressures, Loads and Torque



Applied Pressures, Loads and Torque

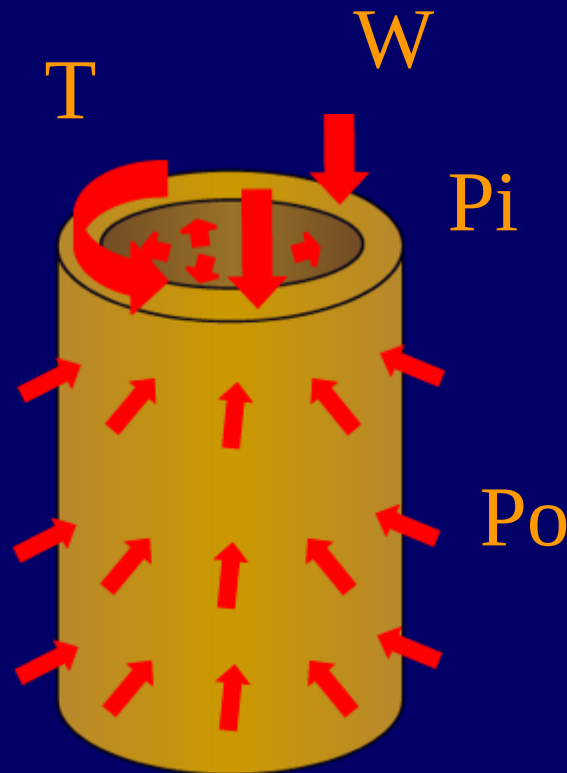


Applied Pressures, Loads and Torque

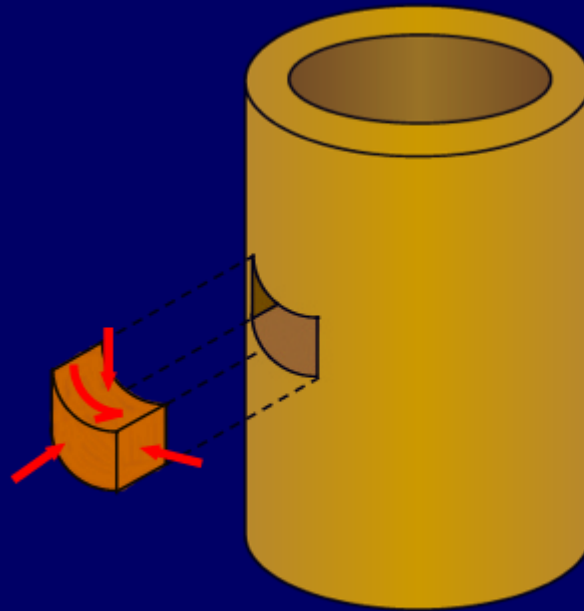


Applied Pressures, Loads and Torque

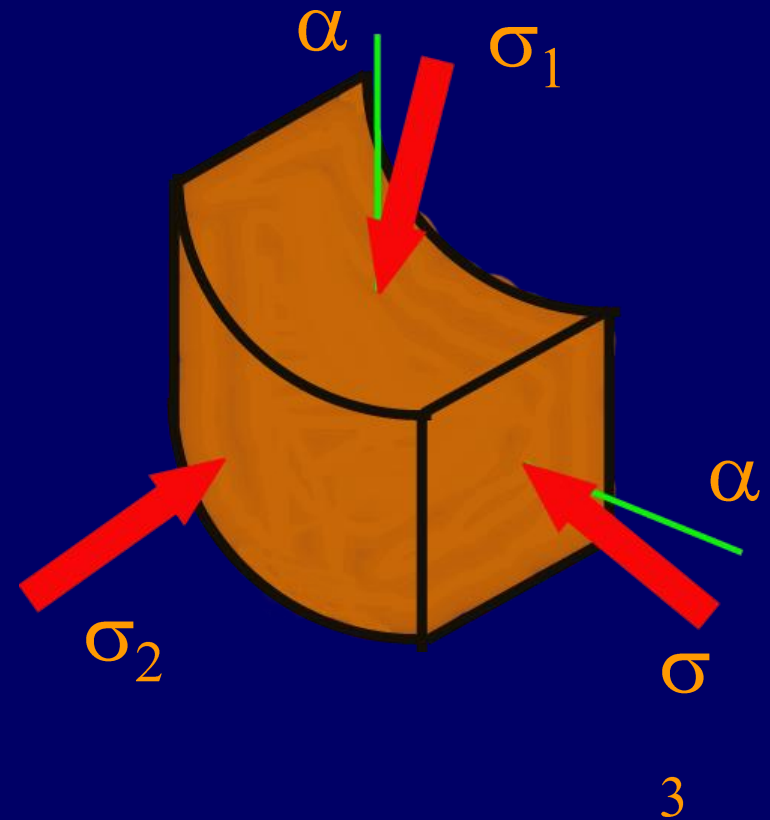
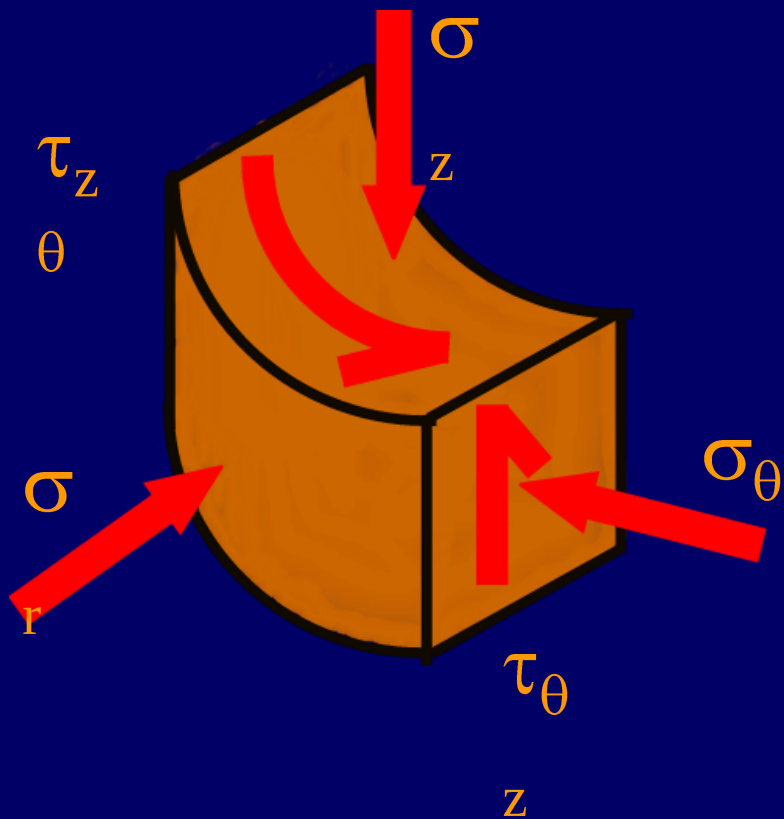
Measure pore
pressure
response



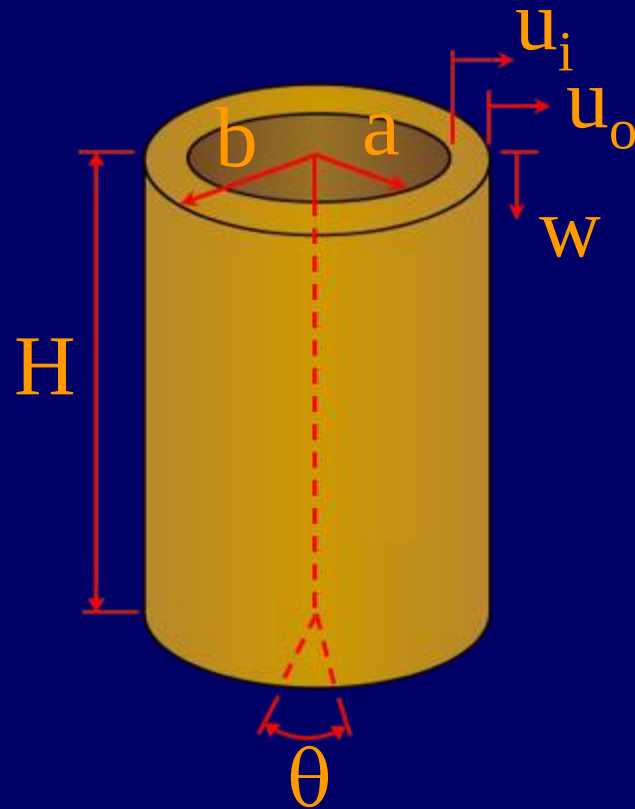
Element of HCA Sample



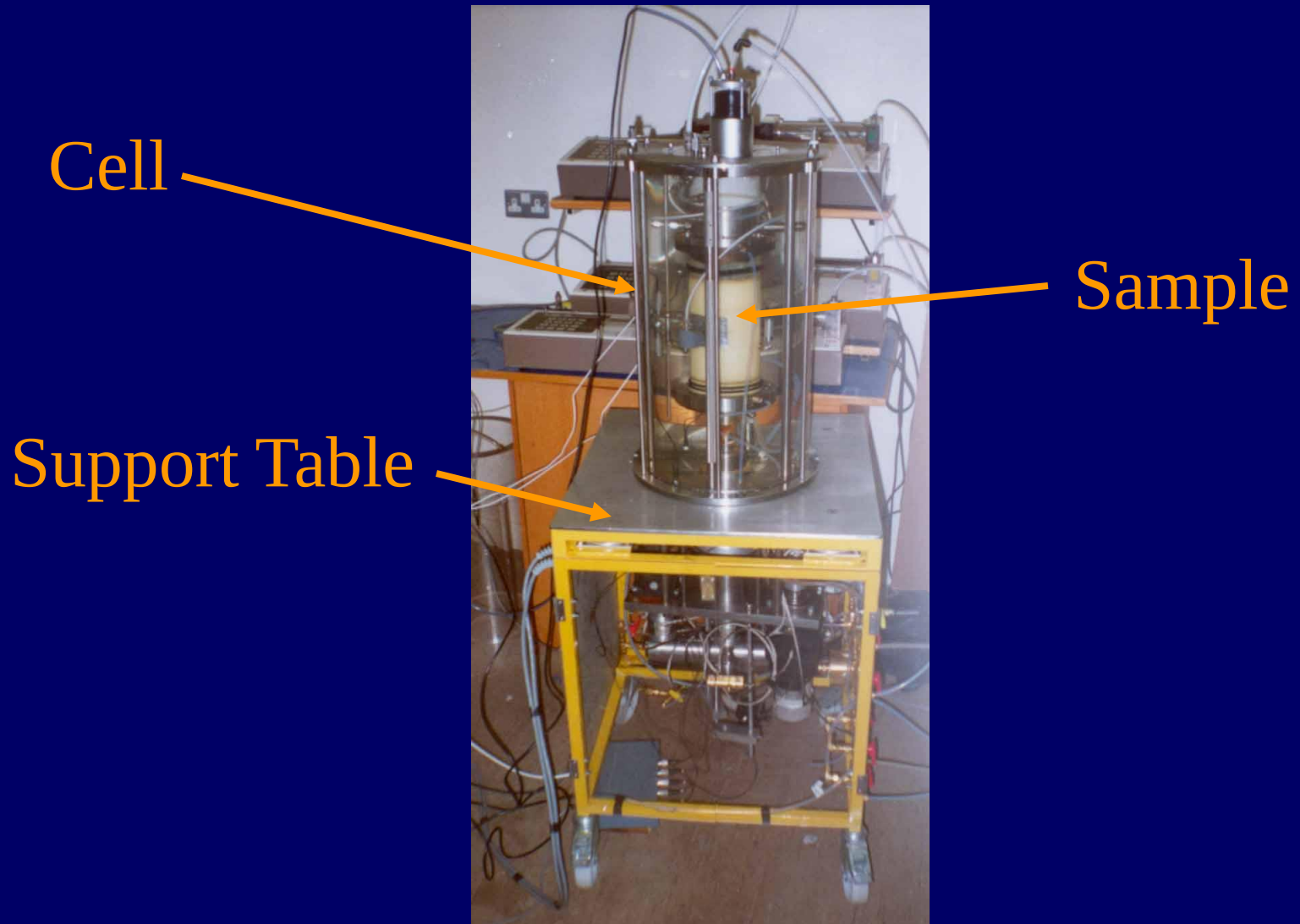
Element of HCA Sample



HCA Displacements and strains



The UCDHCA

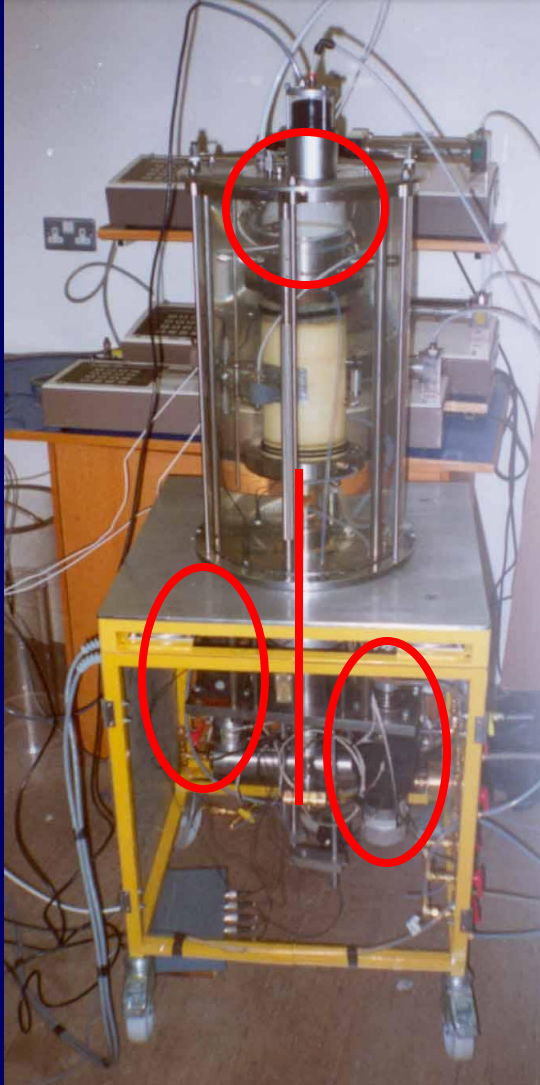


Application / Measurement of Pressures, Axial Load and Torque



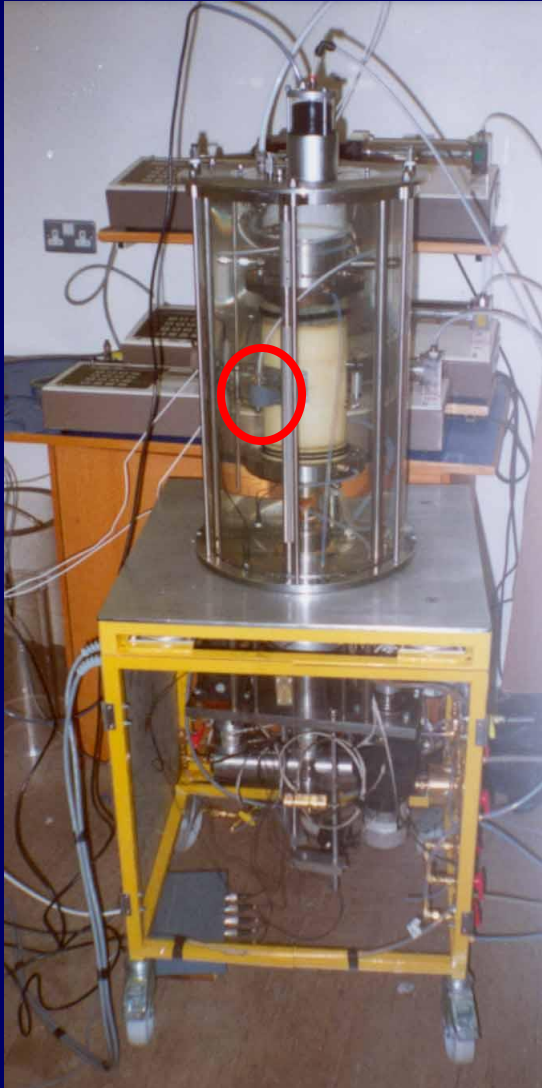
- P_i , P_o and Pore Pressure
 - GDS digital controllers
 - Pressure application / measurement
 - Volume change measurement

Application / Measurement of Pressures, Axial Load and Torque

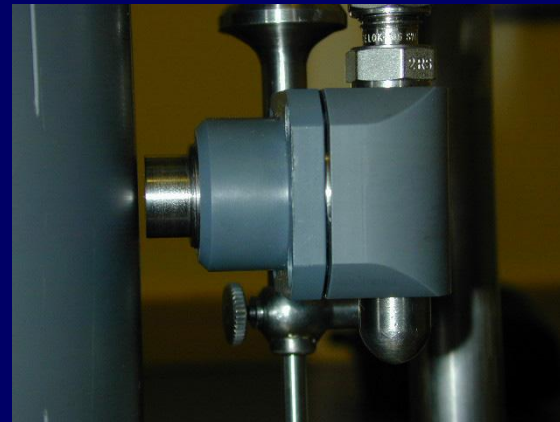


- W and T
 - Stepper motors and spline shaft
 - Control of stepper motors linked to torque thrust transducer
- Differential pressure transducer
 - $P_o - u$

Measurement of Displacements

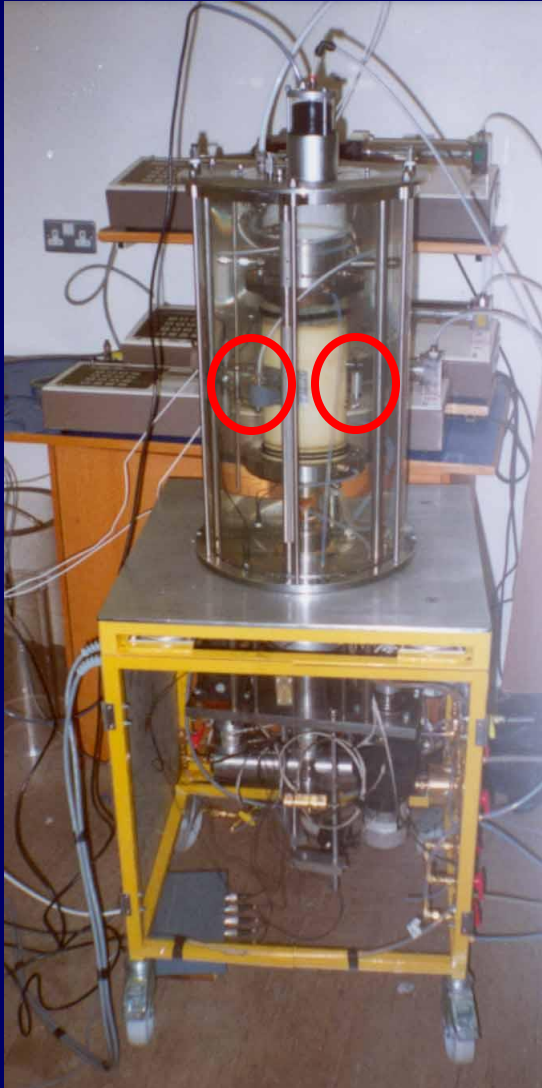


Internal measurements

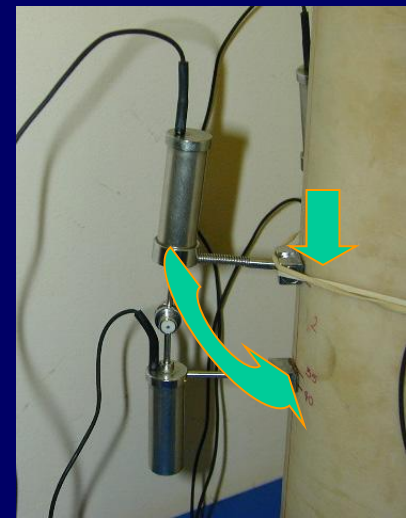


- Proximity transducers
 - Internal and external deformation of sample wall

Measurement of Displacements



Internal measurements



– IC Inclinometers

- Twist of sample
- Twist and axial deformation of sample

Measurement of Displacements



External measurements

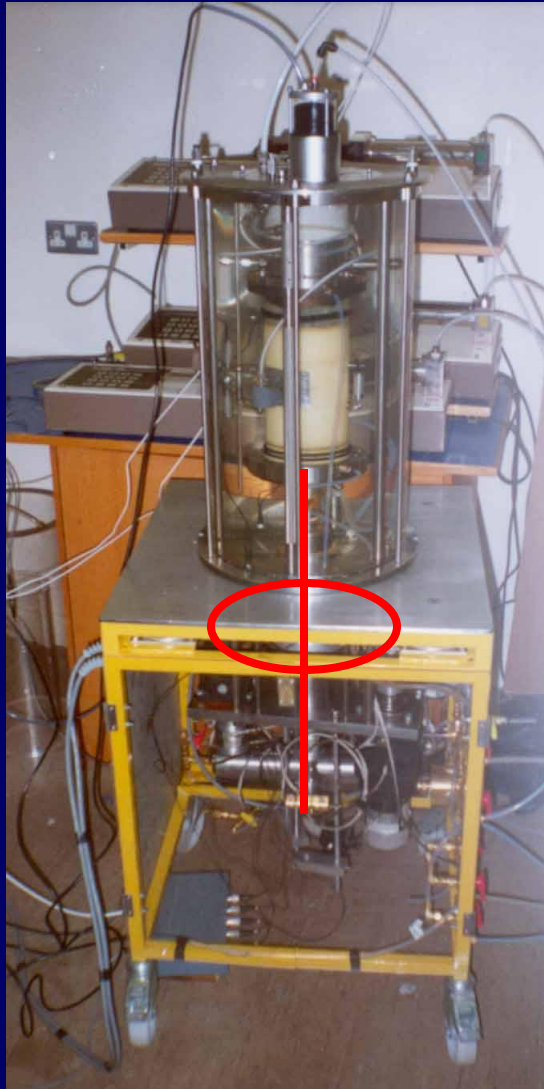
– LDVT

- Axial deformation of sample

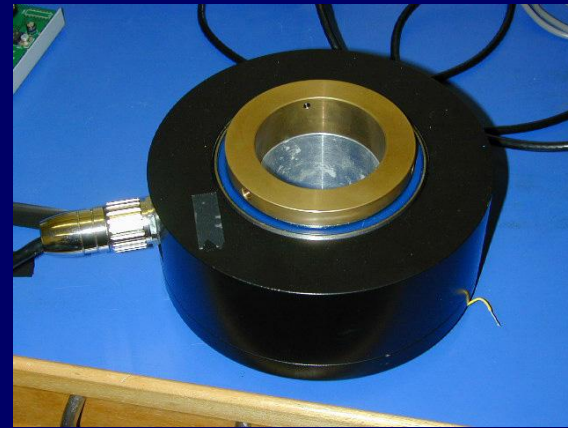
– Volume change

- Bore, cell and sample
- Internal and external deformation of sample

Measurement of Displacements



External measurements



- Encoder
 - Twist of spline shaft

Resolution of Instrumentation

Instrument	Resolution	Full scale	DAQ
Proximity	0.0001 mm	6 mm	24 bit
IC Incl A	0.00125 mm	20 mm	24 bit
IC Incl T	0.0015 ⁰	+/- 30 ⁰	24 bit
LDVT	0.01 mm	50 mm	16 bit
Encoder	0.018 ⁰	∞	16 bit
Vol Change	0.1 cc	200 cc	16 bit
Torque	0.001 Nm	50 Nm	16 bit
Thrust	0.01 kN	4 kN	16 bit
Diff Pressure	0.1 kPa	500 kPa	16 bit
GDS Volume	0.5 cc	200 cc	GPIB
GDS Pressure	0.5(C) 0.2(M) kPa	2000 kPa	GPIB

Strain

2×10^{-5}

Stress,
Normal

0.25 kPa

Use of HCA Test Results

- HCA can be used to:
 - Carry out fundamental investigation of soil behaviour
 - Develop material constitutive models
 - Model real problems
- All with rotation of the major principal stress and independent control of the intermediate principal stress

Thank You