

Experimental and Theoretical Study of Unsaturated Fine Soil

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Motivation



Economic Aspect

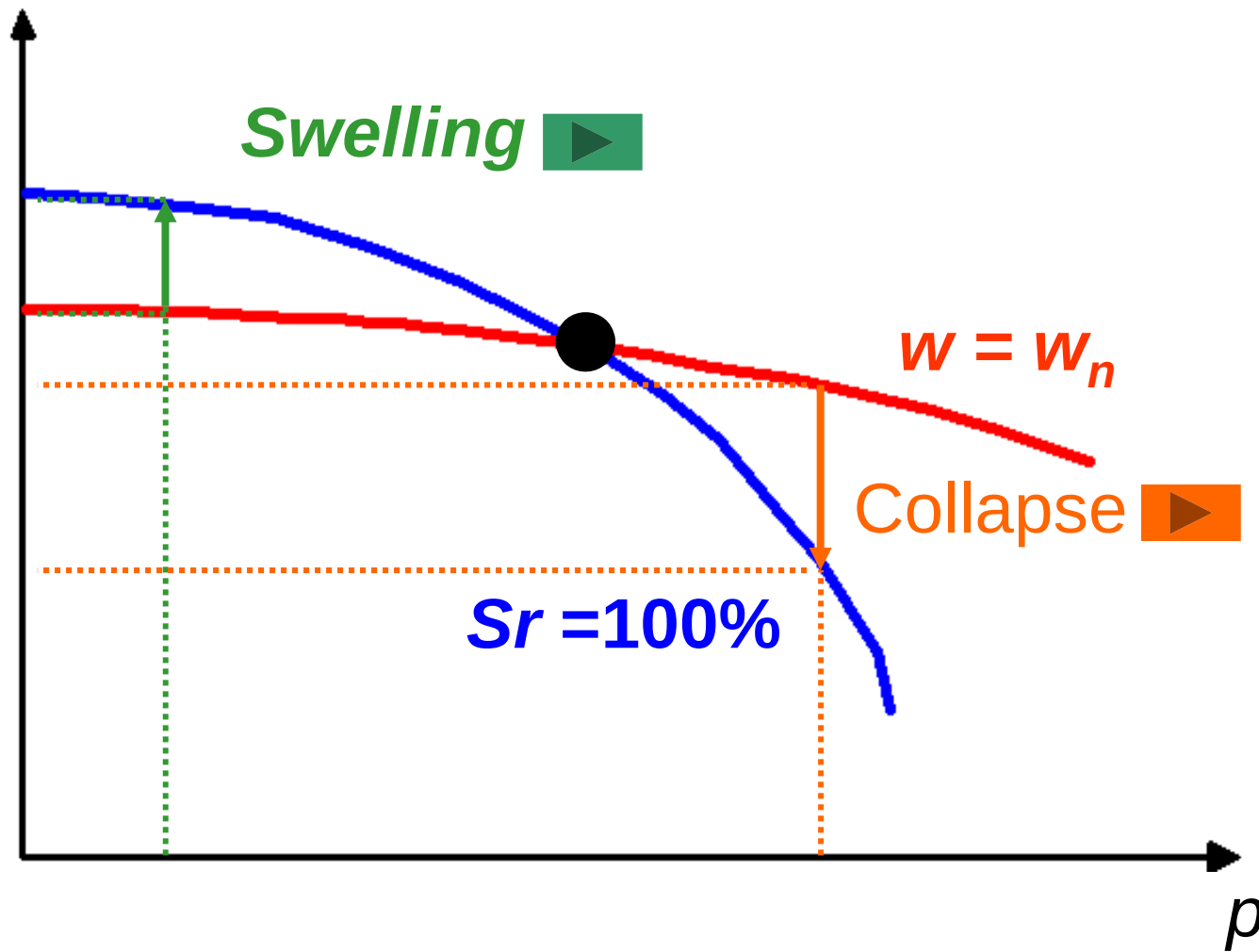
Spain **500** millions ptas/year (Rodriguez Ortiz, 1974)

USA **7** billions of \$/year (Krohn y Slosson, 1980)

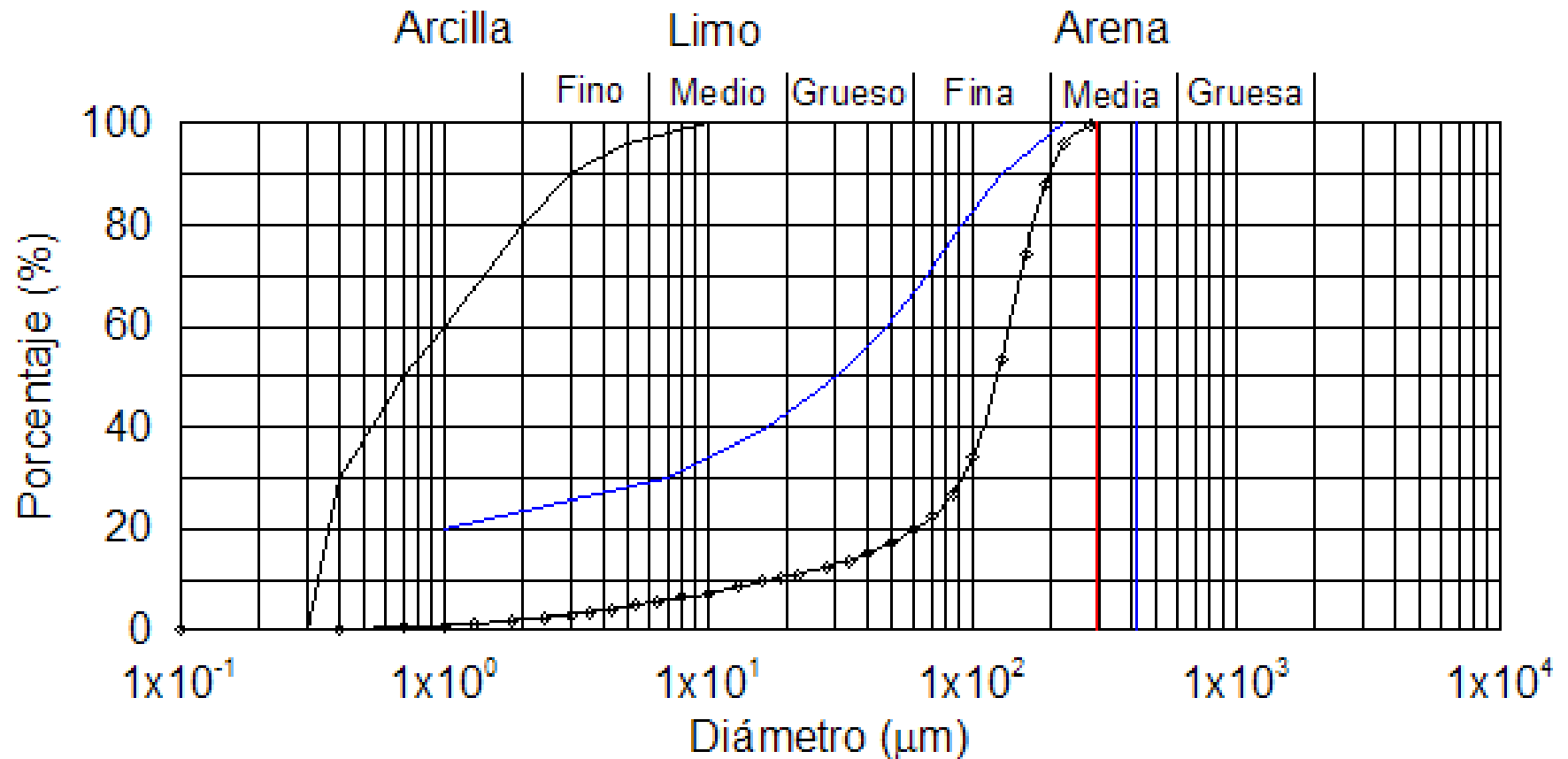
Swelling :

Streets and highways	55.5%	
Commercial buildings	16.0%	
Housings	13.3%	
Airports	6.2%	
Buildings	3.5%	
Others	5.5%	

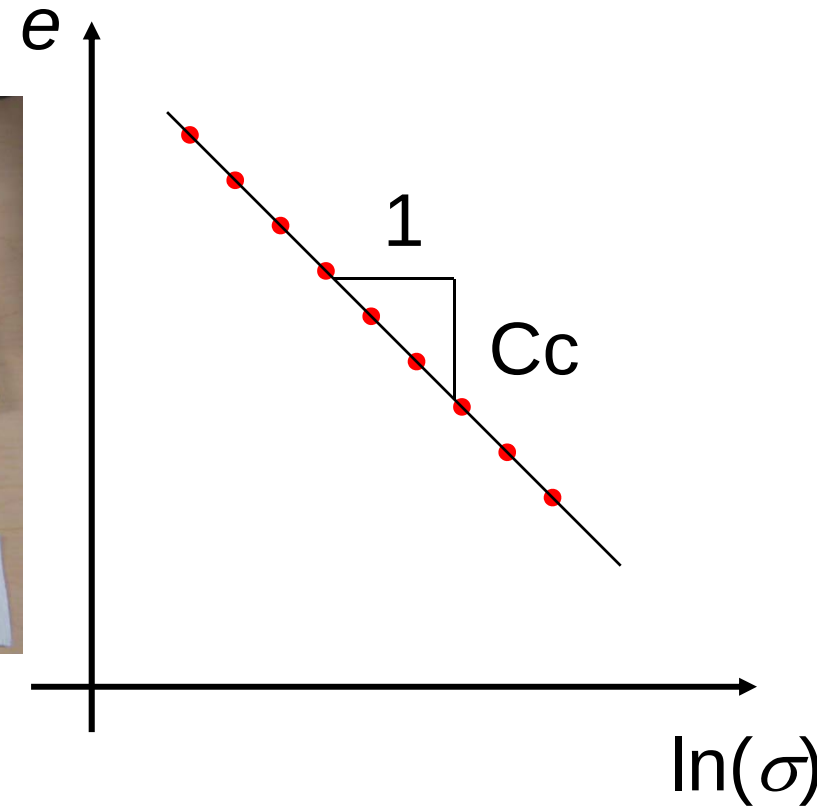
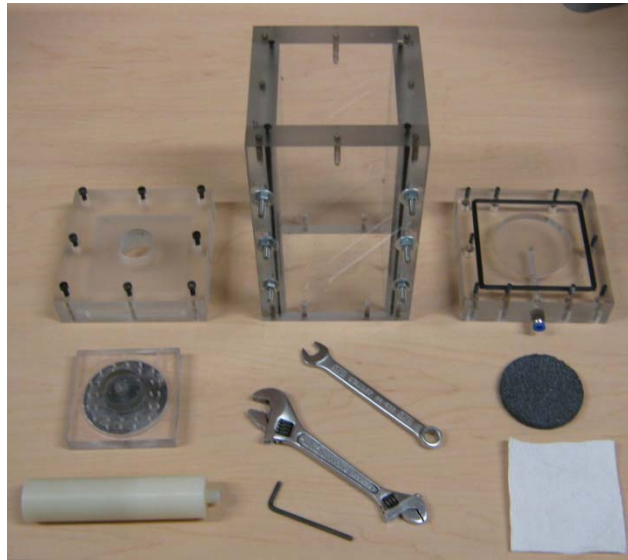
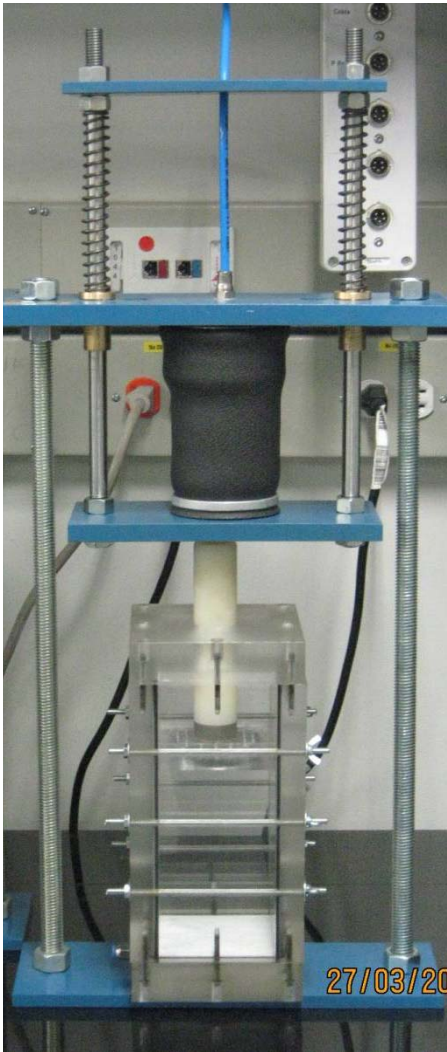
Volume change



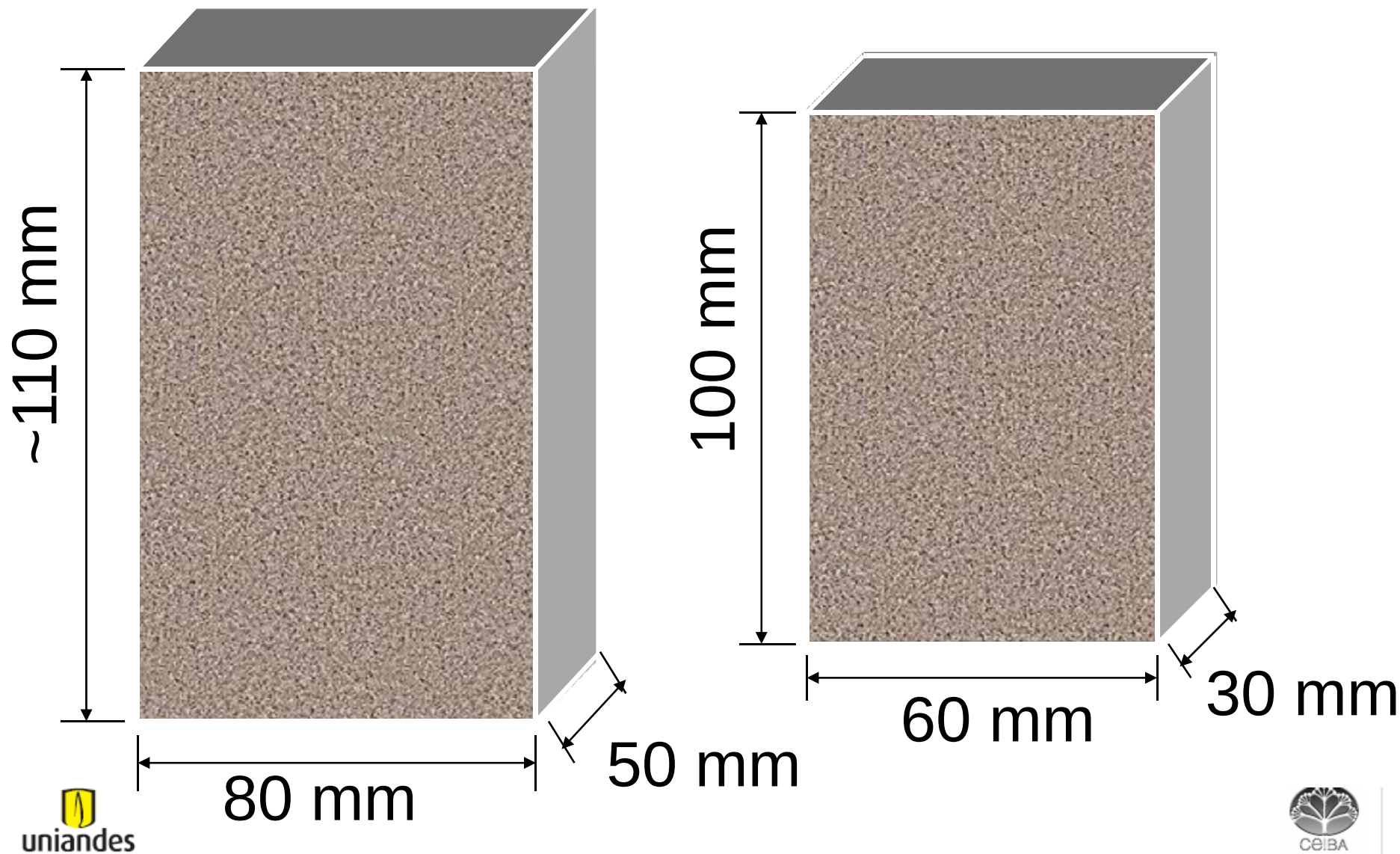
Soil



Consolidometer



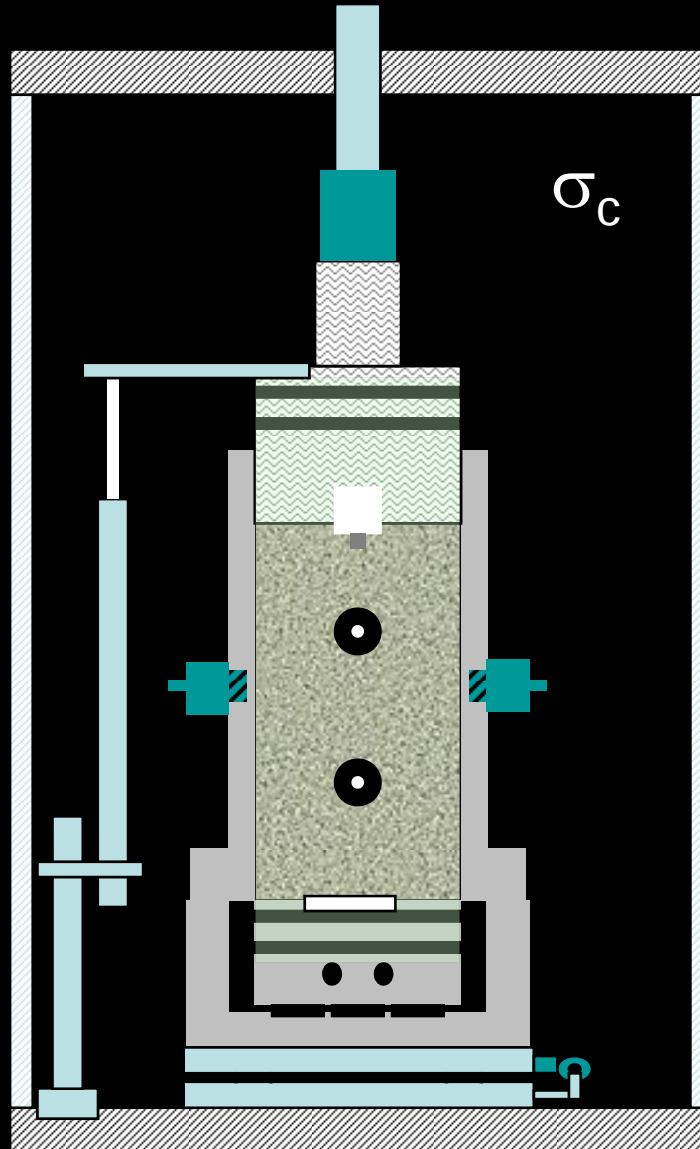
Saturated specimen



Membrane



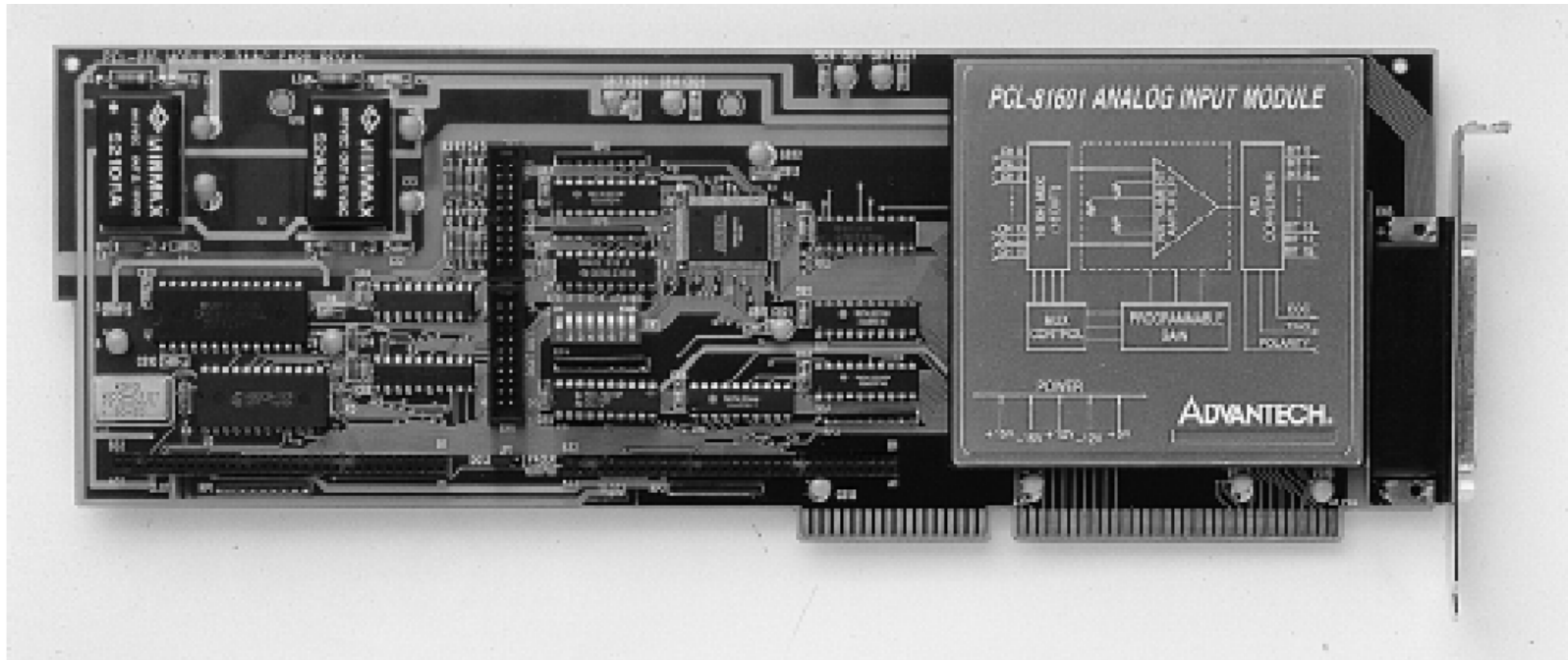
Membrane



Biaxial



DAS card PCL 816

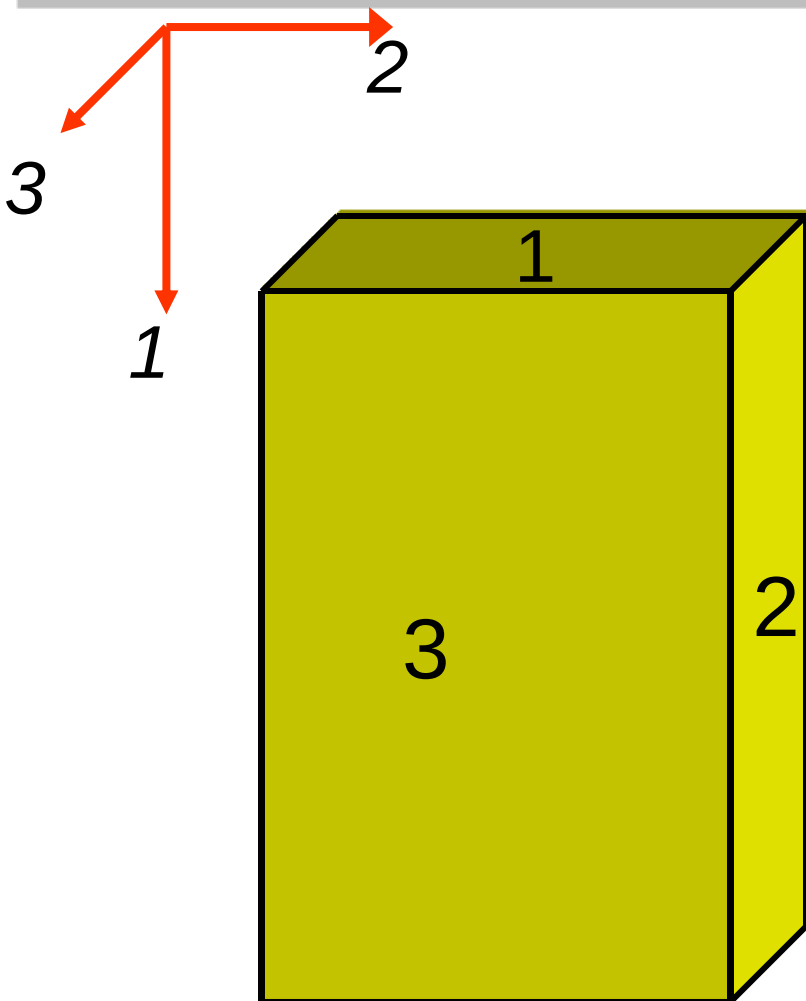


16-bit resolution A/D converter

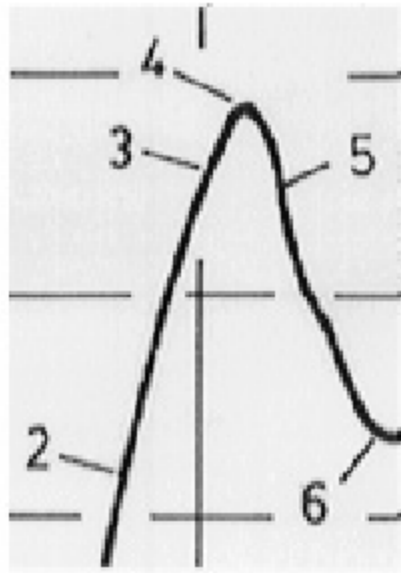
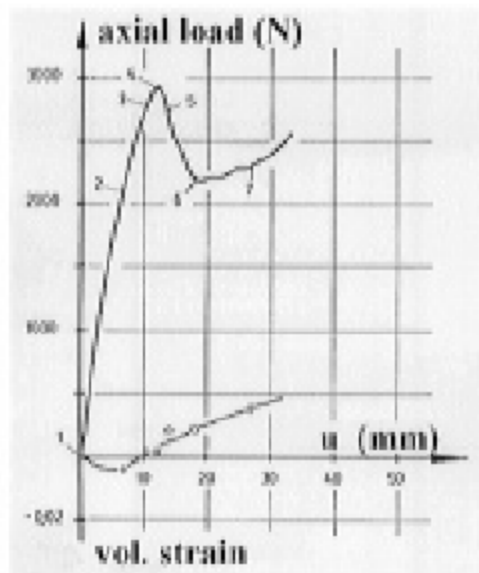
100 kHz sampling rate

16 channels

Biaxial



Biaxial



Drained
(Dense sand)
 $h=340$ mm
 $b=100$ mm
 $e= 35$ mm
 $\sigma_3= 80$ kPa



1-2

uniandes



2-3



3-4



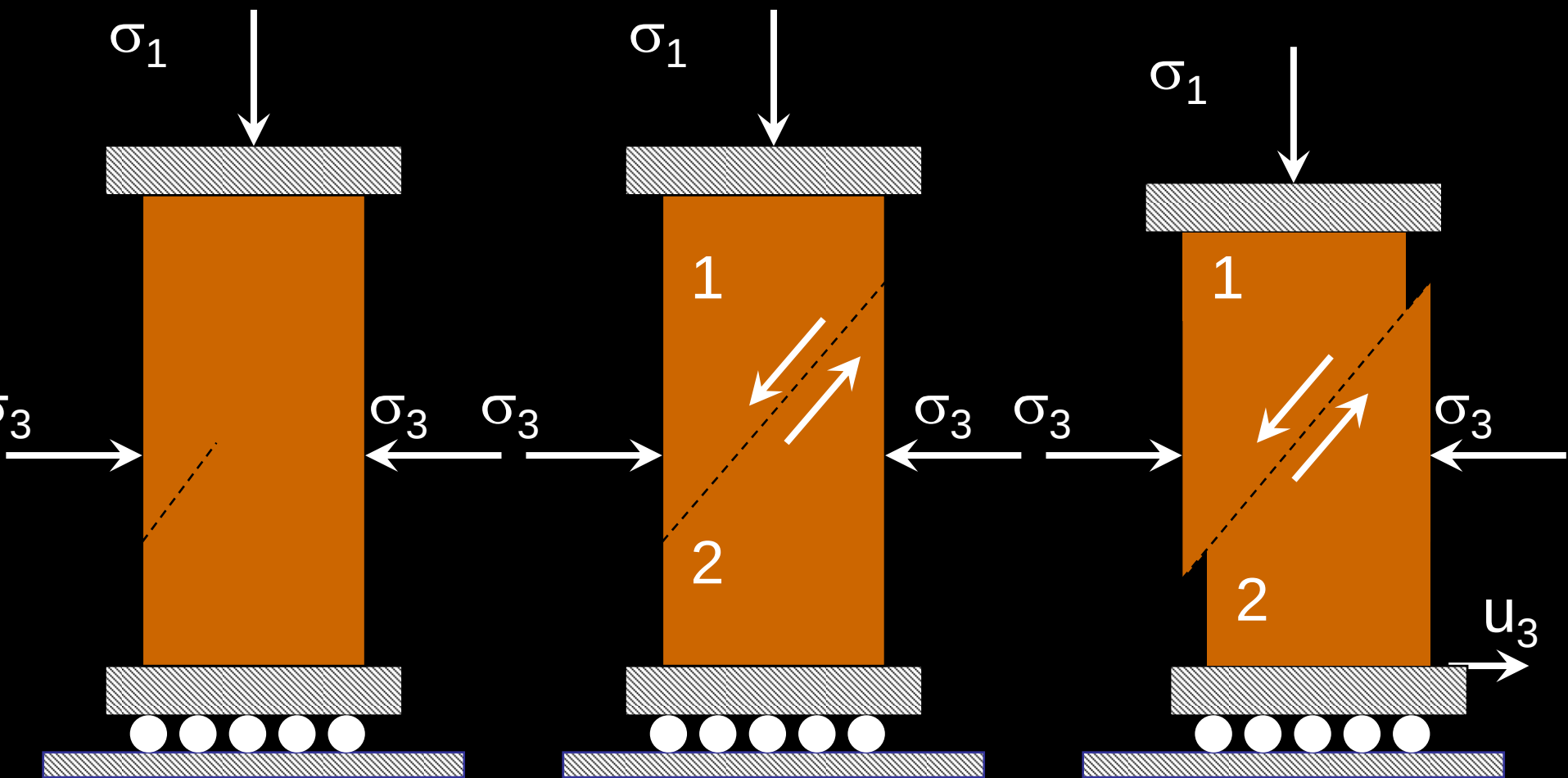
4-5



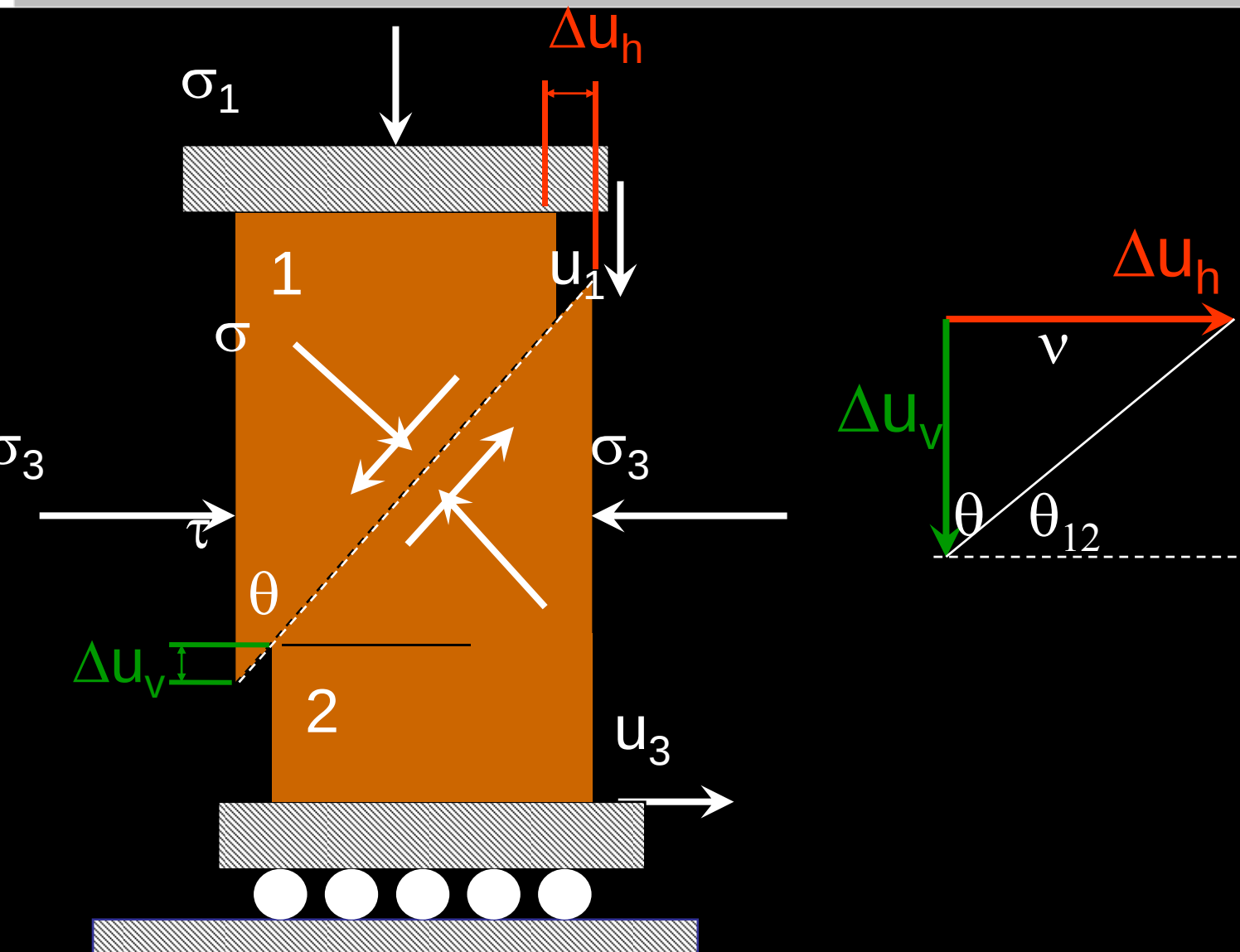
5-6



Biaxial



Biaxial



Biaxial

	σ_1	σ_2	σ_3	Δ_1	Δ_2	Δ_3	S	
Drescher, Vardoulakis and Han	2 ↑ ↓	x	σ_c	2 ↑↑	0	4 ⇒ ⇒ ⇐ ⇐	x	1 ↔
Lizcano	1 ↑	x		1 ↑		x	x	
Ruiz, Lizcano and Cruz	4 ↑ ↑ ↑	2 → ←		1 ↑		4 ⇒ ⇒ ⇐ ⇐	1 ↑	

Acknowledgements

CeiBA

FIN

Streets and highways



Housings

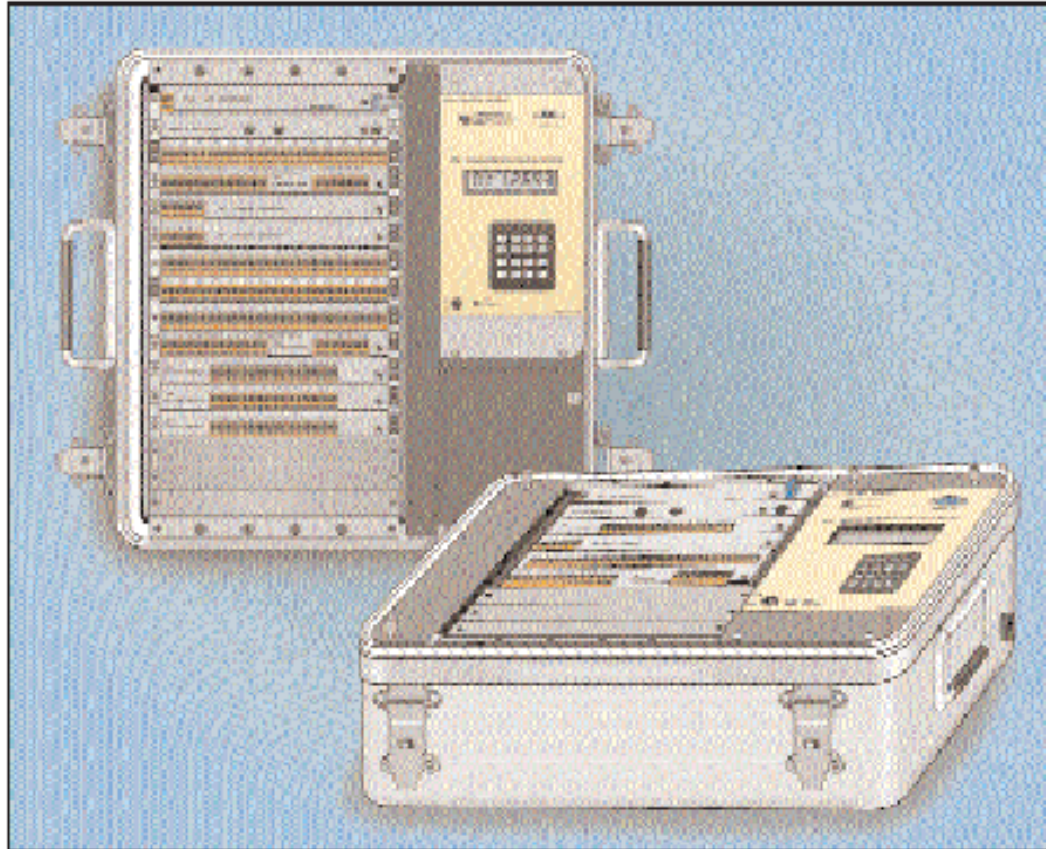


Collapsing



Psychrometer

CR7



16-bit resolution

250 kHz sampling rate

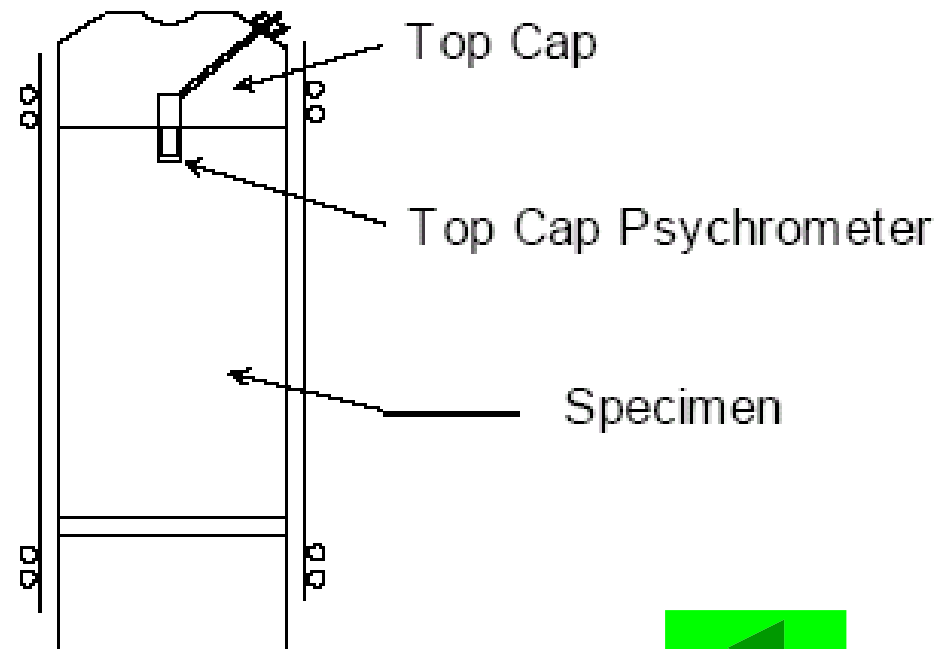
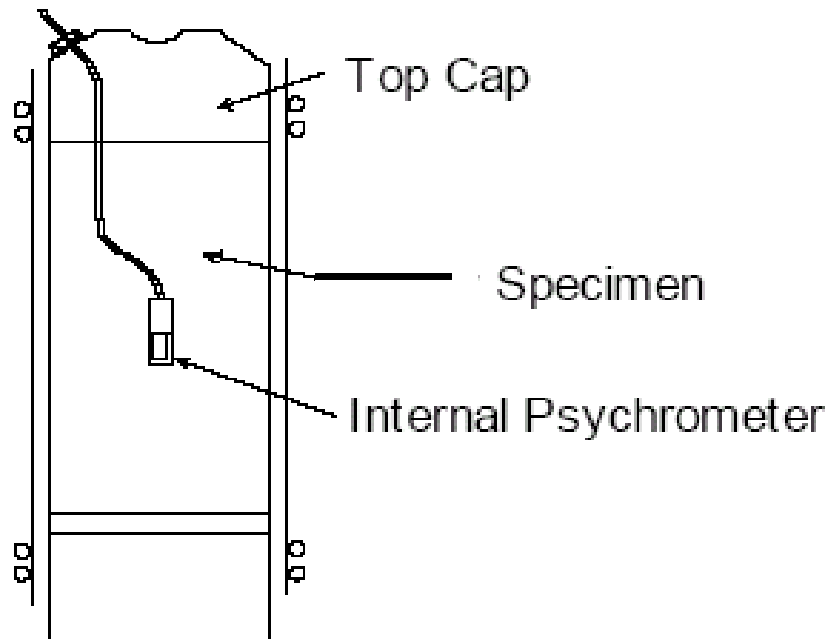
20 channels



PST-55



Psychrometer



Blatz *et al*

Subminiature Pressure Transducer



Range: 3.4 MPa

Excitation: 5 VDC

Accuracy: 1% FS

Cost: 740 \$



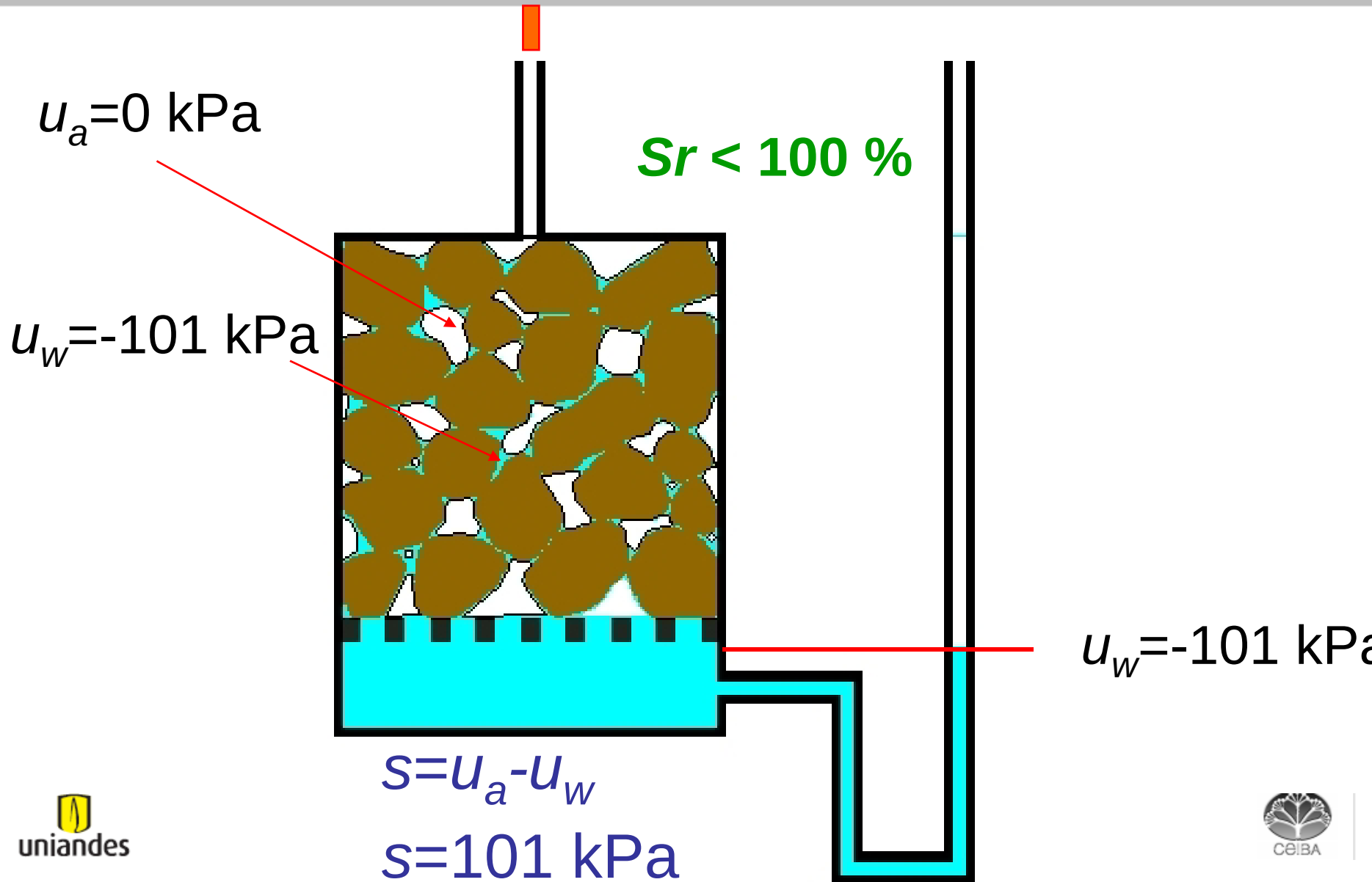
High air entry disk



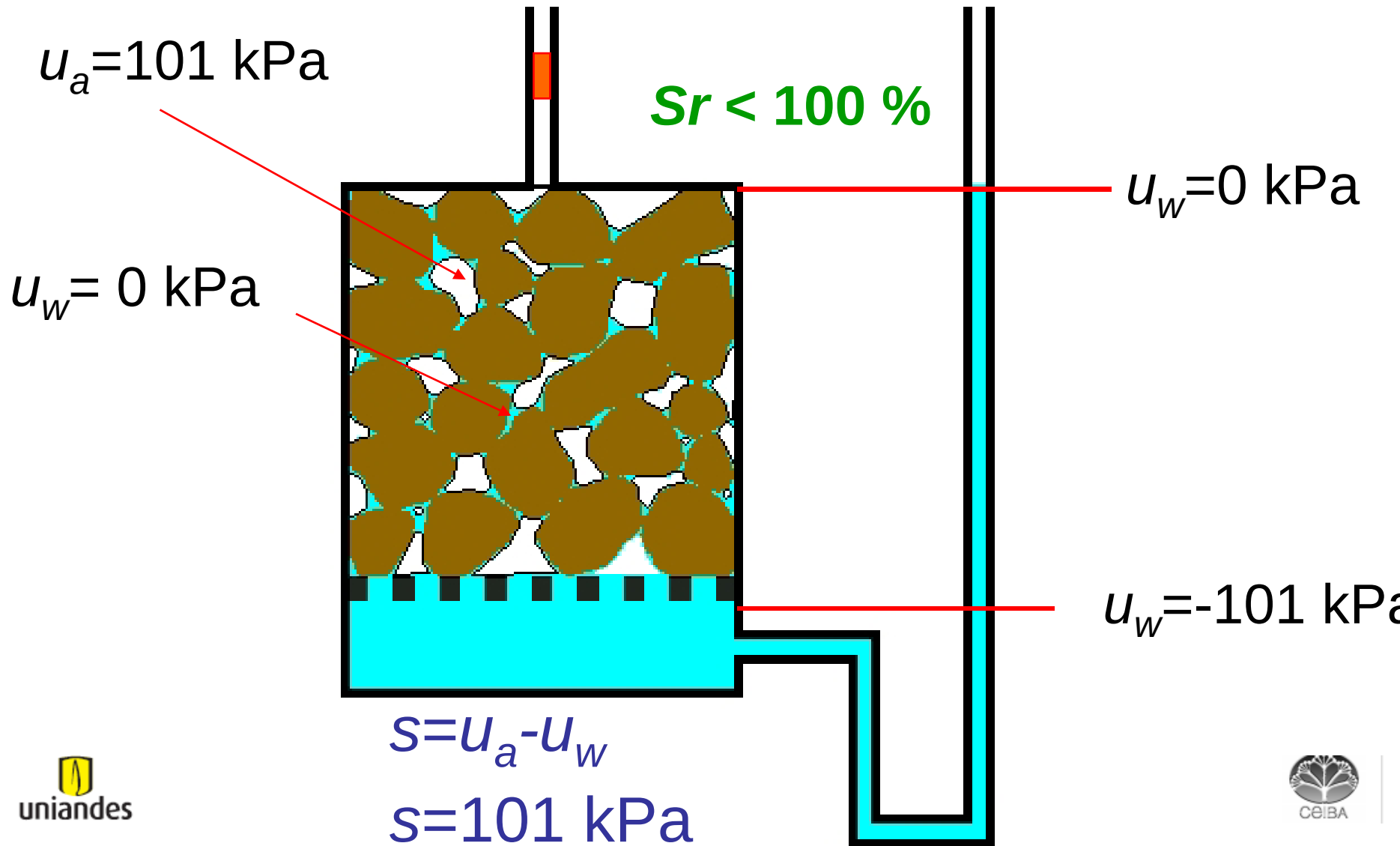
0.0505 MPa - 1.5 Mpa
 6.0×10^{-3} mm - 0.16×10^{-3} mm

Cost: 147 \$

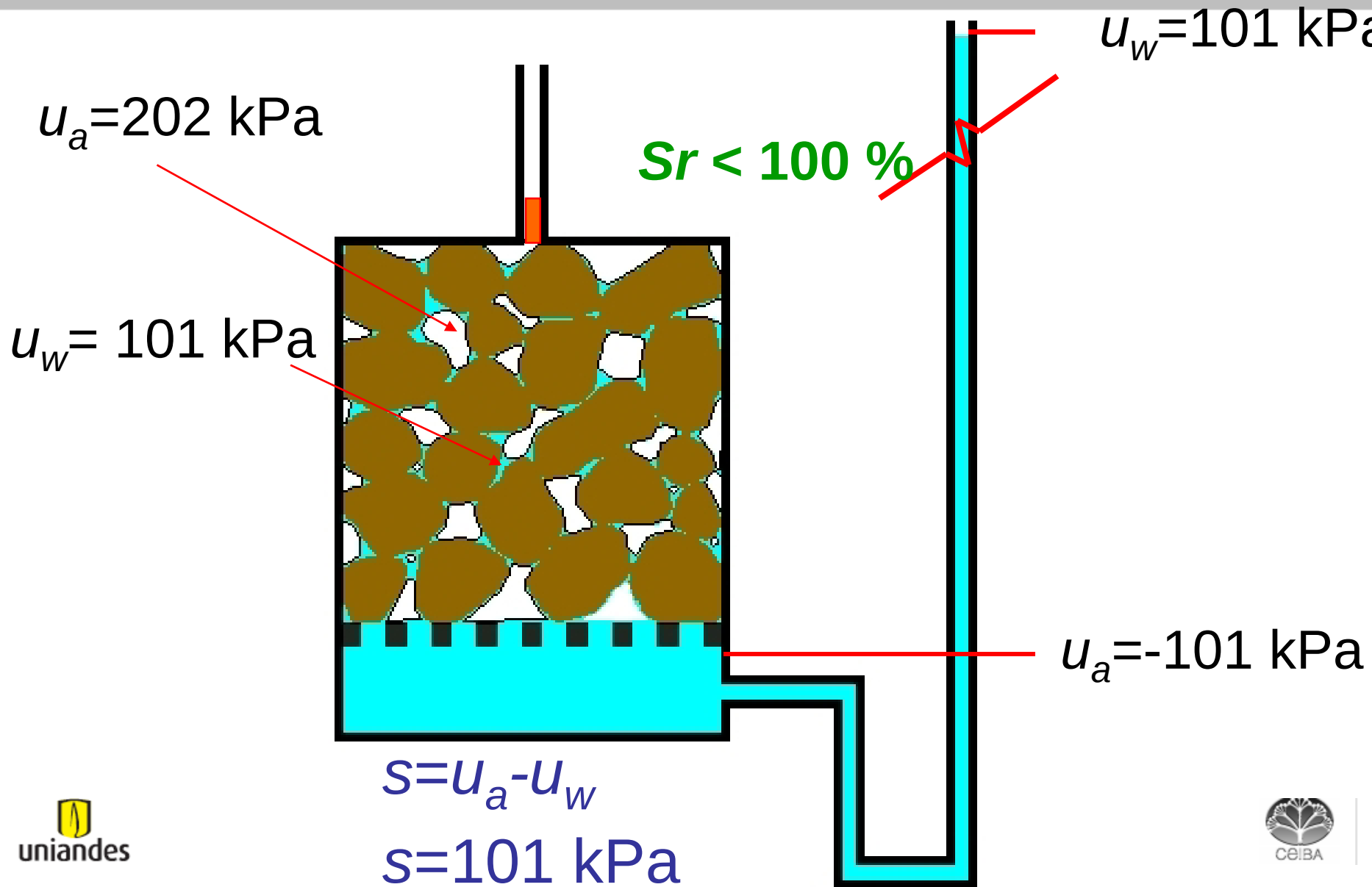
Axis Translation



Axis Translation



Axis Translation



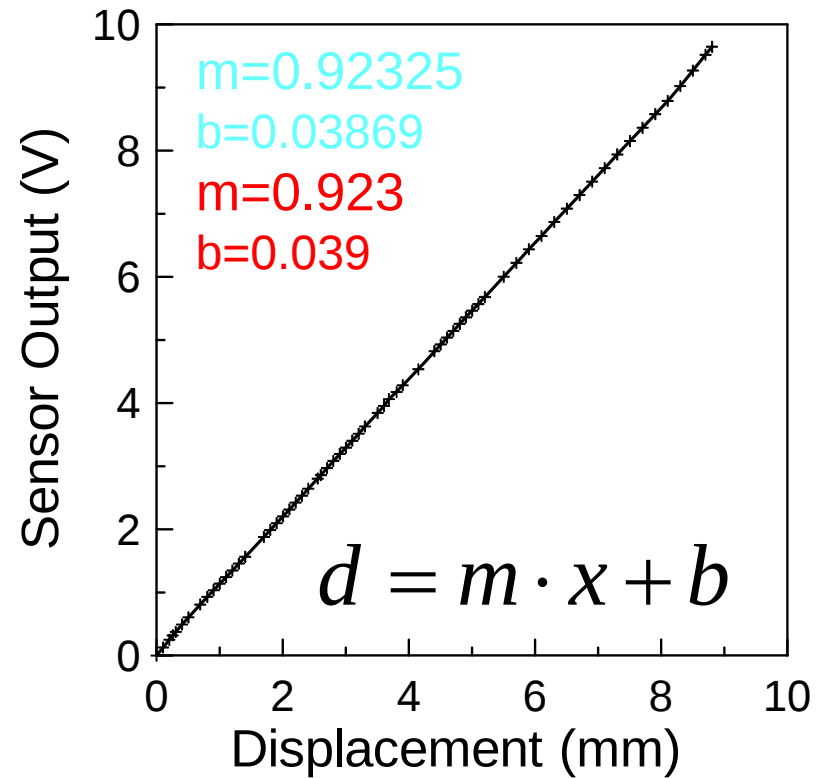
LVDT (Linear Variable. Differential



Range: ± 4.5 mm

Power: 5 vol

Cost: 6 653 \$



Subminiature Load Cells (Model 13)



Range: 4.4 kN

Accuracy: 0.5%

Power: 5 VDC

Cost: 1185 \$



LVDT (Linear Variable. Differential Transformer)



Range: ± 0.5 in

Linearity: ± 0.25 % F.S

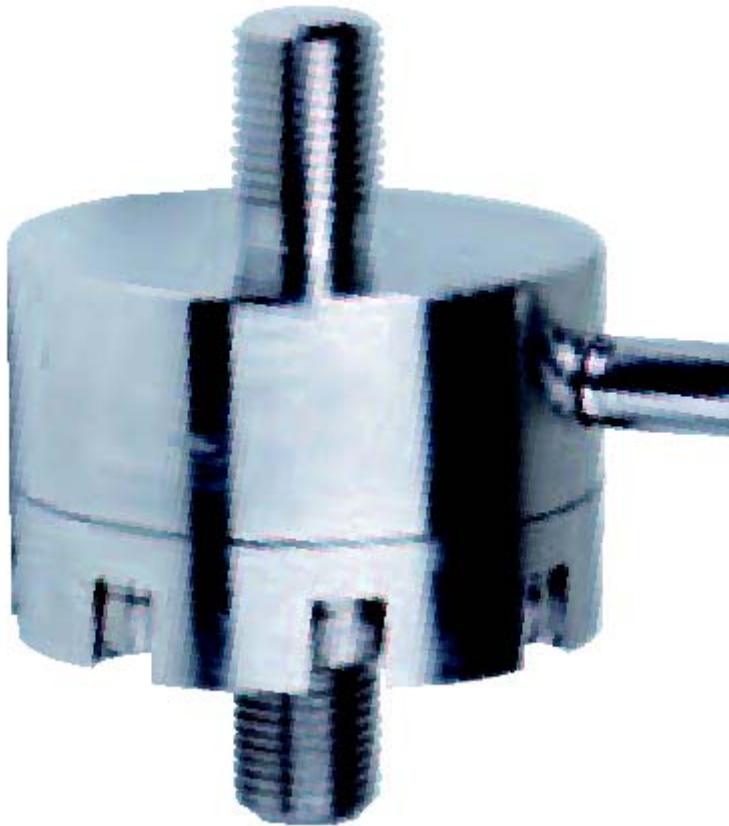
Power: 3V RMS @ 5 KHz

Cost: 6 653 \$ + 728 \$ + 447 \$

LVDT (Linear Variable. Differential Transformer)



Load Cells (LM317)



Range: 50 kN

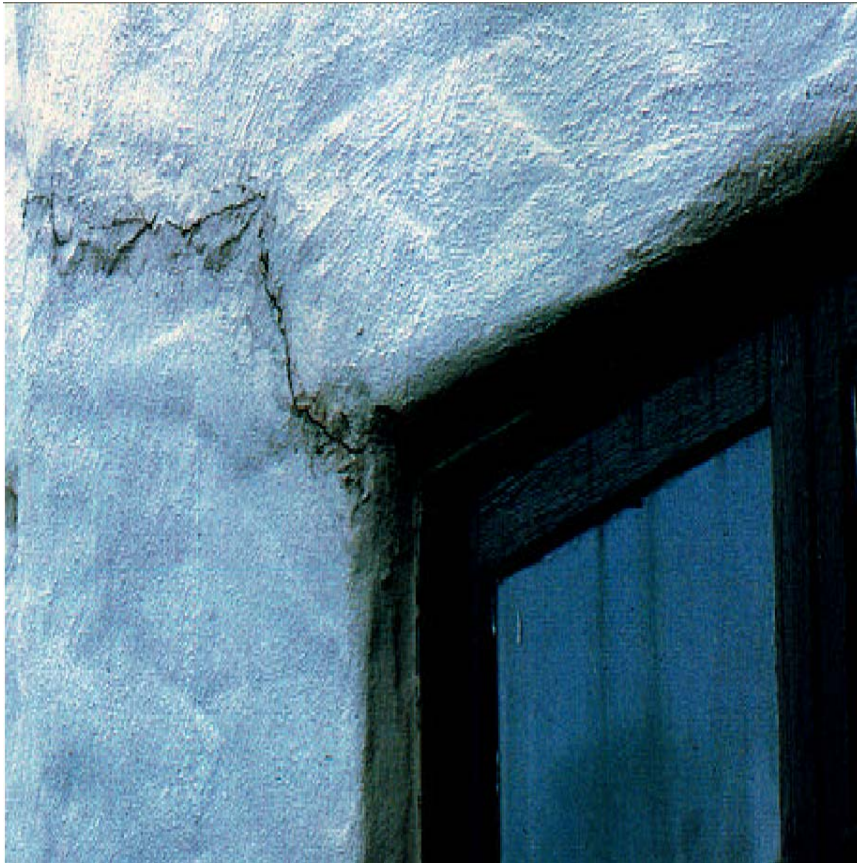
Accuracy: 0.5%

Power: 10 VDC

Cost: 575 \$



Housings



Housings

