

Moisture Effects on PVD and DCP Measurements

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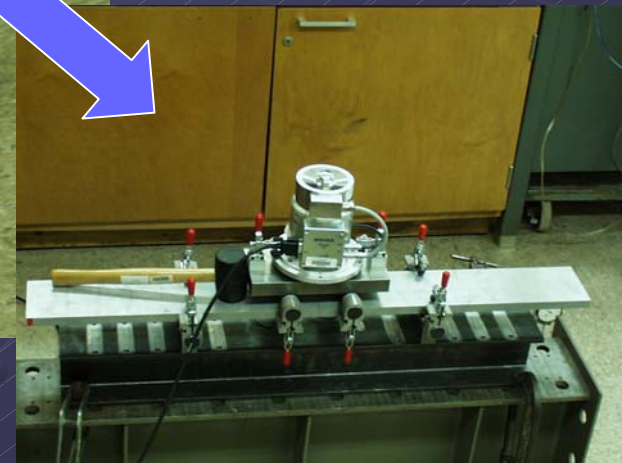
University of Minnesota

Objectives

- Granular base and subgrade materials:
Laboratory vs. Field testing
- Field measurements: global, small-strain
(spatial variation of stiffness, density, moisture ...)
- Lab measurements: local, “large”-strain
- **Moisture effects**

Portable devices (stiffness testing)

Humboldt, Loadman, Prima



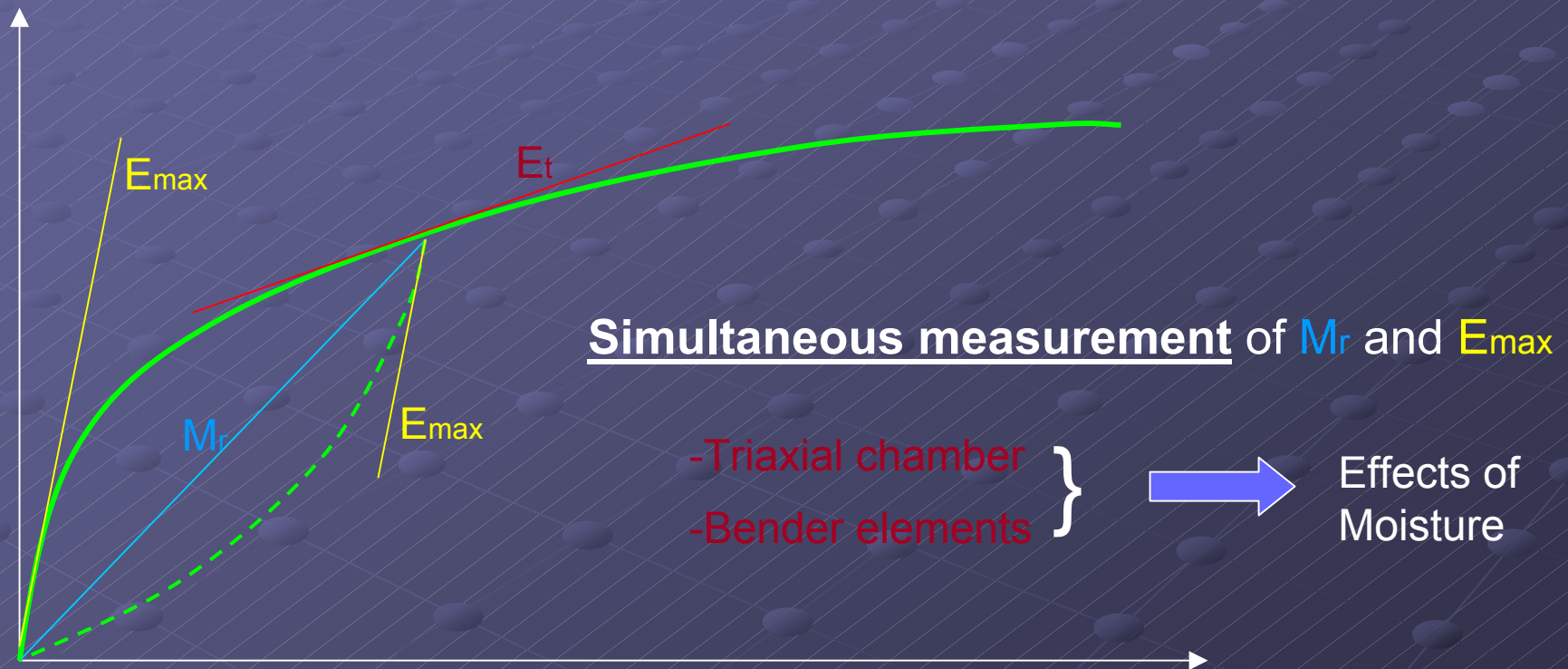
Small vs. "large" strain

Low frequency ($< 200\text{Hz}$)

Depth of penetration $> 1\text{m}$

Laboratory Testing (Stiffness)

- Resilient modulus vs. small strain (seismic estimates)

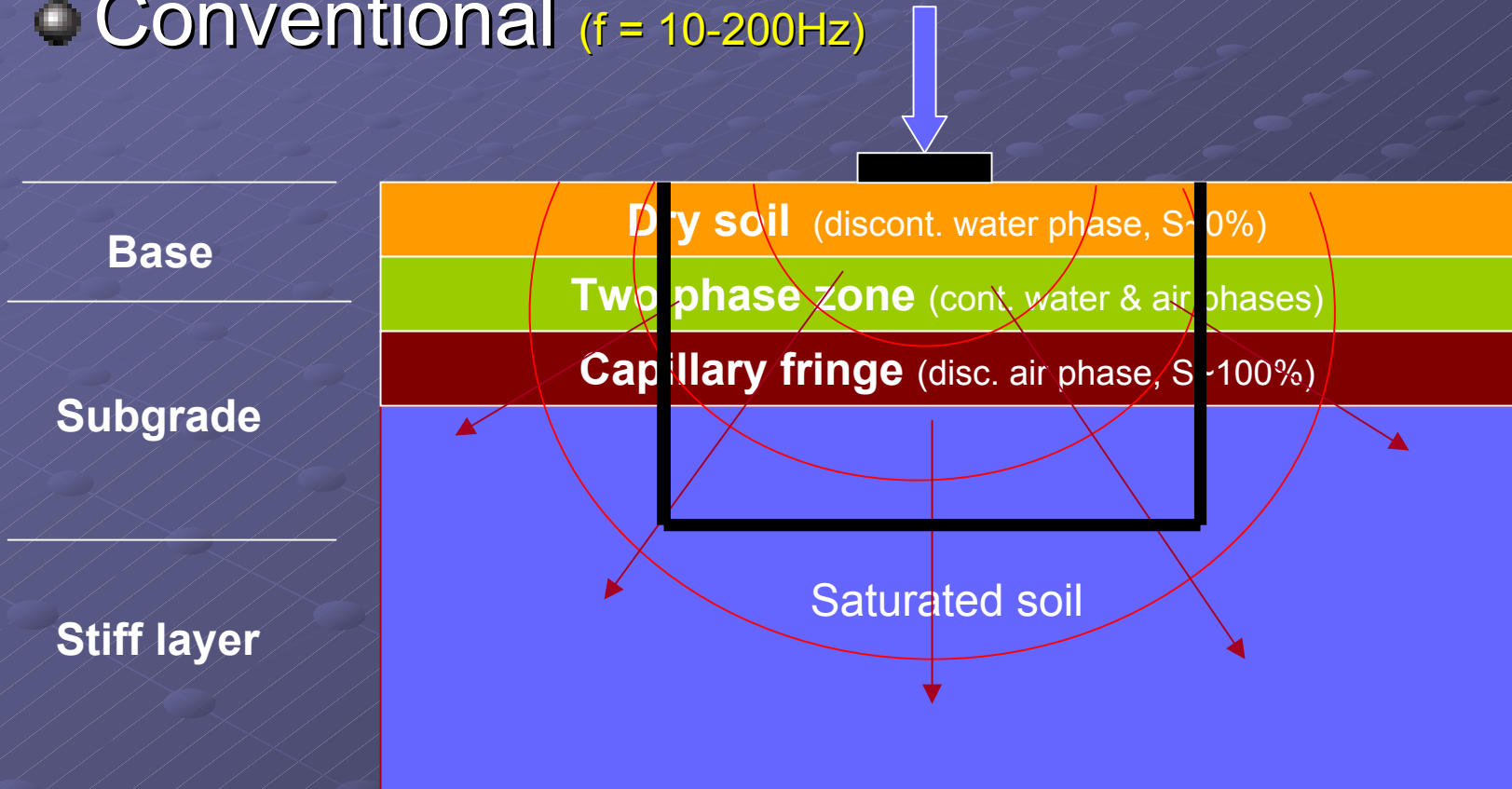


M_r - design (performance estimation)

E_{max} - construction (quality assurance)

Field testing (full/reduced scale)

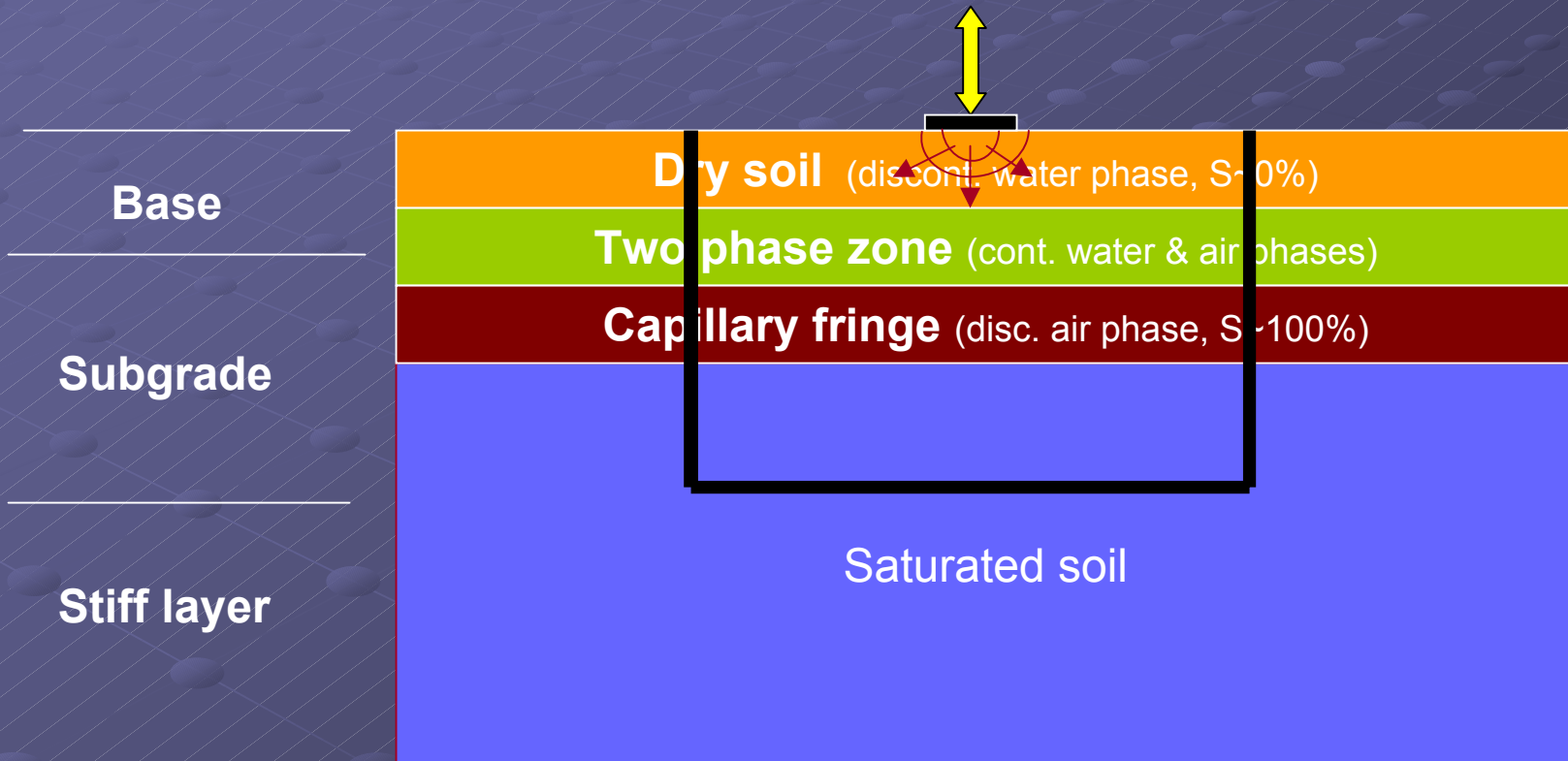
● Conventional ($f = 10-200\text{Hz}$)



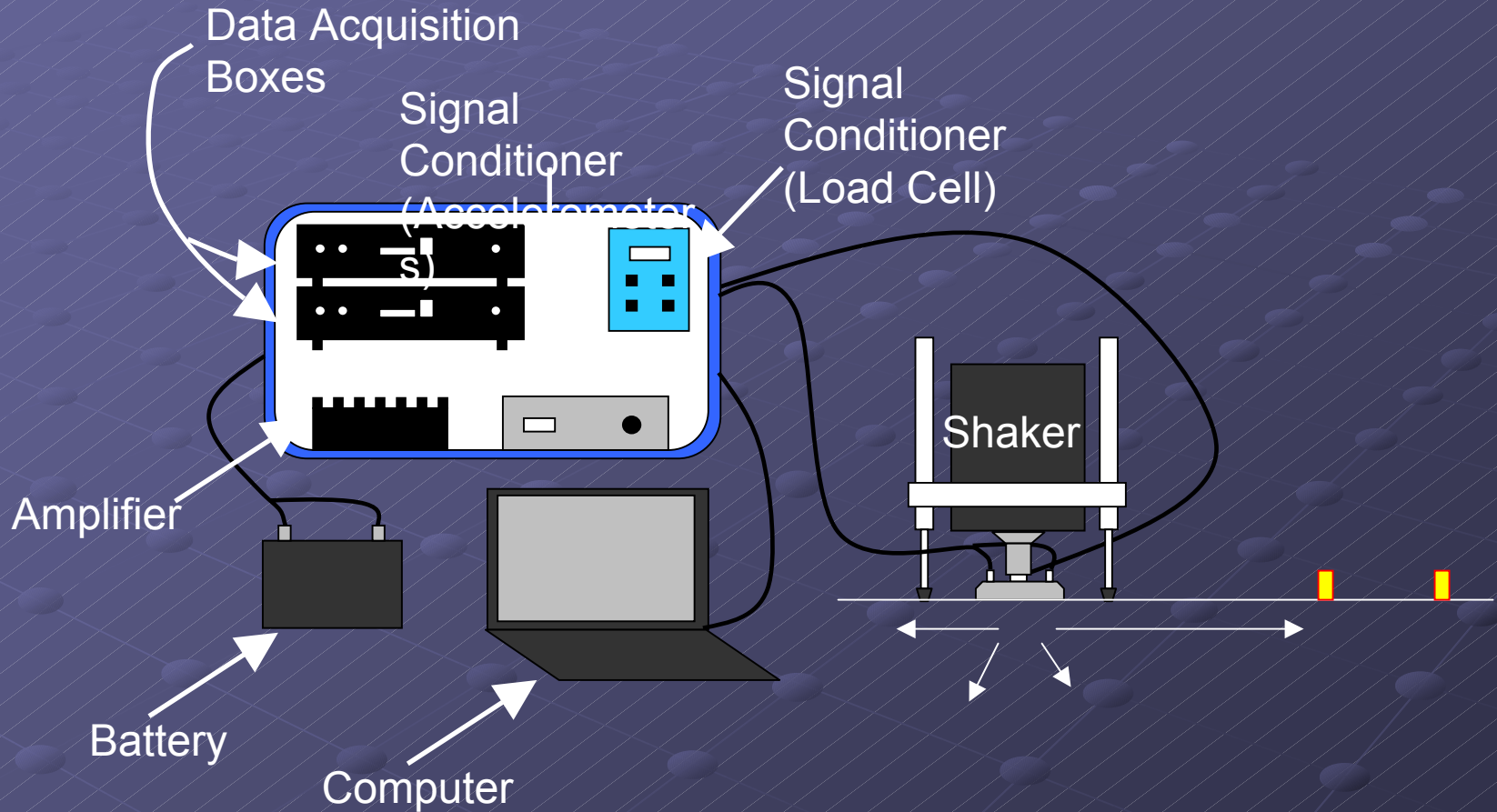
Fredlund (1999)

Field testing (full/reduced scale)

● PVD ($f = 1-2 \text{ kHz}$)



Portable Vibratory Deflectometer



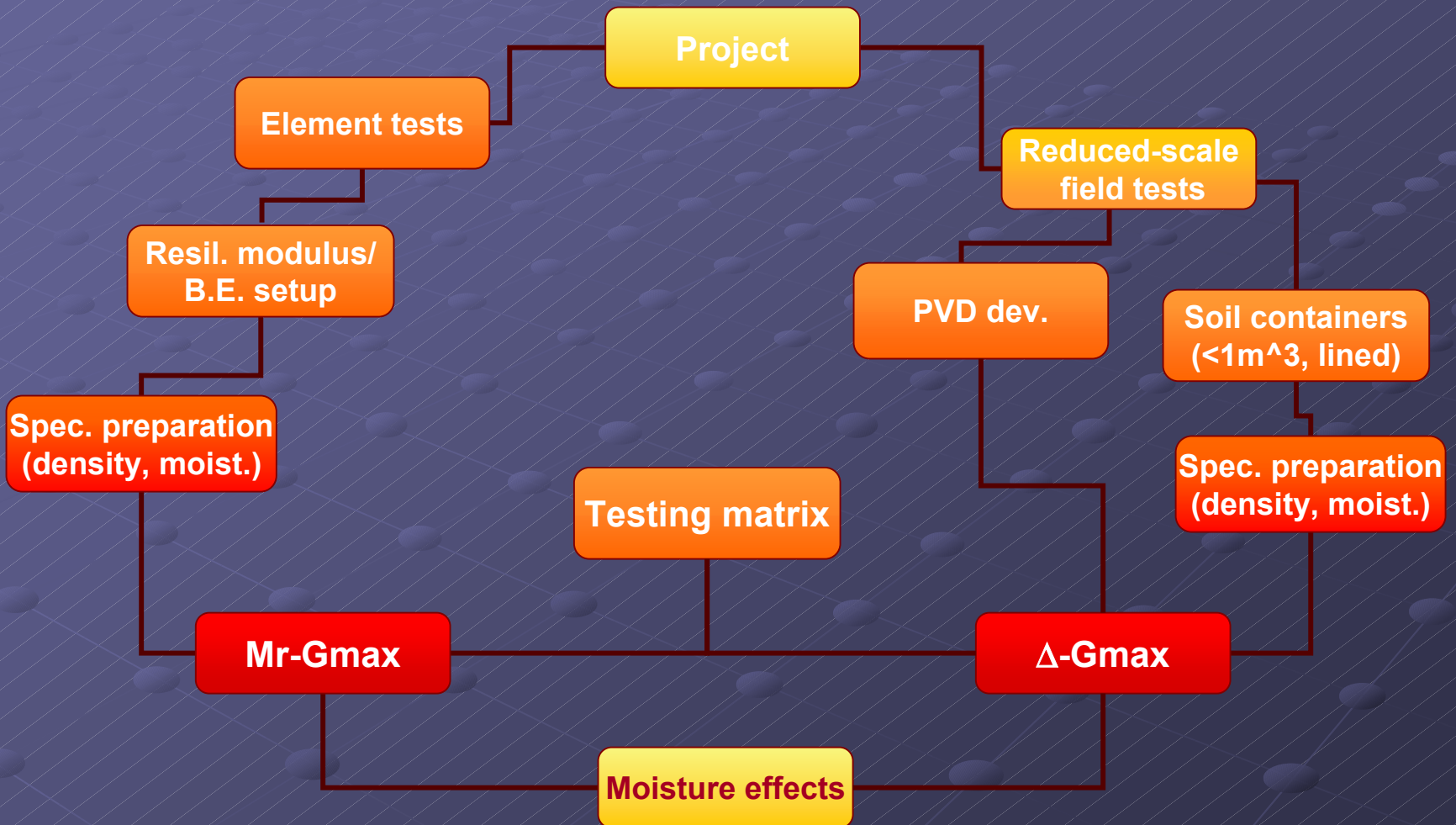
Freq. range 1-2kHz

Random/harmonic excitation

Depth of penetration = 0.1-0.2m

Seismic energy

Developments



Issues

- M_r vs. E_{max} (bender) vs. E_{max} (small-scale) vs. E_{max} (field?)
- $E_{max} > M_r = k_1 \sigma_d^{k_2} \sigma_c^{k_3}$
- Effects of moisture on k_1, k_2, k_3 ?
- Moisture variation within soil specimens?
- E_{max} : **seismic** – grain size limitation (coupling)?
- Relationship with FWD?
- Bender vs. resonant column