



**Geotechnical Engineering Technology Adoption - Are We Up to Date,  
Using the Right Tools?**

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**Wednesday May 22, 2024**

**1:50 to 2:15pm**

# How about a math quiz before we start...?

- Engineers are good at math...right?

- $\infty / 2 = \text{what?}$

- $\infty / 5 = ?$

- $\infty / 25,000 = ?$

No matter how finely you cut an infinite set, the answer is the same...just try an electron microscope!

# Math over. How about a little History...

- Advancing Civil, Soil Mechanics, Geotechnical Engineering profession has been a life long pursuit for many engineers (forgive me if I missed one of you or one of your favorites):
  - Karl Terzaghi from 1920's to 1960's - use mechanics rather than Rules of Thumb
  - Ralph Peck from 1940 to 2008 - use soil mechanics in foundation engineering.
  - Authur Cassagrande, ASCE committee head 1930's through 1940's – Unified Soil Classification
  - Paul Mayne, Peter Robertson, Ken Stokoe and others - Field Investigation using CPT testing and Geophysics

# Topic of adopting new Technology - Not New

- Came to Albuquerque 1990. Went to work for SHB Geotechnical Engineers.
- First thing I had to do was get “computers” on each engineers desk
- In 1992 SHB “gave” me to the DOE - lead engineer on the UMTRA project.
- Thank you to the USA tax payers for spending part of your \$2.3 billion to teach me unsaturated soil mechanics and landfill cover design from some of the best engineers in North America including Van Genuchten, Morgenstern, Daniels, Benson, and many, many others.
- ASCE Geo-Congress Panel Presentation, 1.5 hours, in Atlanta, Georgia, organized by Dr. Scott Anderson, P.E. who was then with FHWA.

10 years ago, working on raising the bar...



### Panelists

Prof. Richard Finno, P.E., Northwestern University – Lab Testing

Prof. Paul Mayne, P.E., Georgia Tech – Field Testing

Dr. Ken Stokoe, P.E., University of Texas - Geophysics

Dr. John C. Lommler, P.E., AMEC – Problem Solving

### Moderator

Dr. Scott A. Anderson, P.E., FHWA

# 10 years ago, working on raising the bar...

Scott Anderson asked questions to the panel prior to each presentation:

Near-term, mid-term, and out on the horizon:

1. In your view, what beneficial tools and techniques are widely available today and yet not routinely used? Are there reasons why?
2. What new developments do you see becoming standard practice in the future? What are the obstacles to rapid deployment and what steps can be taken to overcome them?
3. What do you see out on the horizon that has potential to be a “game changer” for geo-characterization?

# ***2014 - Current Standard Geotechnical Practice***

- **Field Testing**

- Auger Borings with SPT sampling
- Shelby Tube Samples or Ring Samples

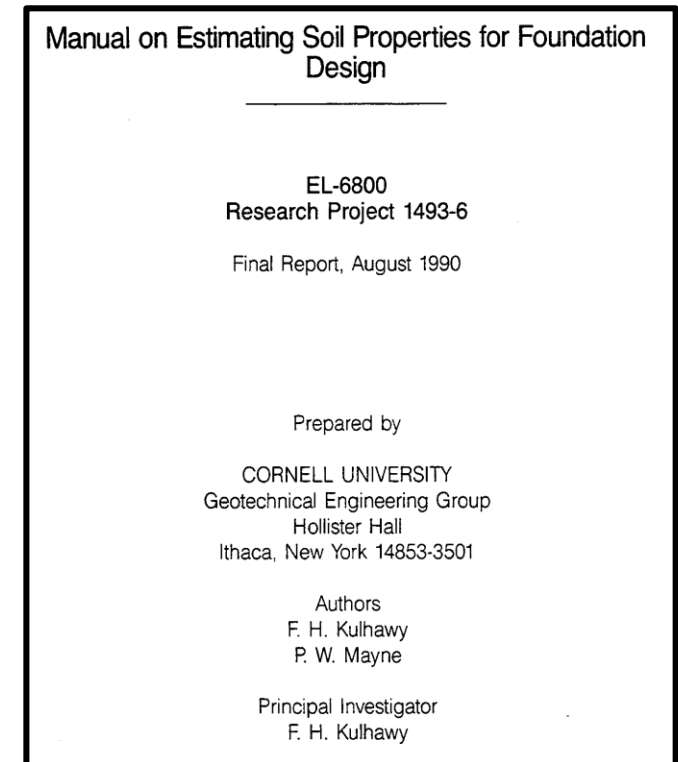
- **Laboratory Testing**

- Classification Tests: Sieves, PI, Moisture Content
- Unconfined Compression Tests
- Direct Shear Tests
- In SW collapse upon wetting, not many consolidation tests. Not sure why specific gravity not done.

- **Geophysics – often not used, except Seismic Site Class**

# Correlated Parameters from SPT, PI, % Passing 200

- Correlated parameters are used in standard geotechnical practice
- They are also used in Chapter 10 of the AASHTO LRFD Design Manual
- Thanks to Drs. Mayne and Kulhawy, we have a great reference:
- Notice the date on this EPRI Manual... 1990
- Aside...Did you ever notice that most geotechnical material comes from FHWA, State Highway Departments, Petroleum Industry, and EPRI research? It's because they put up the money!
- BUT are correlated parameters always OK?

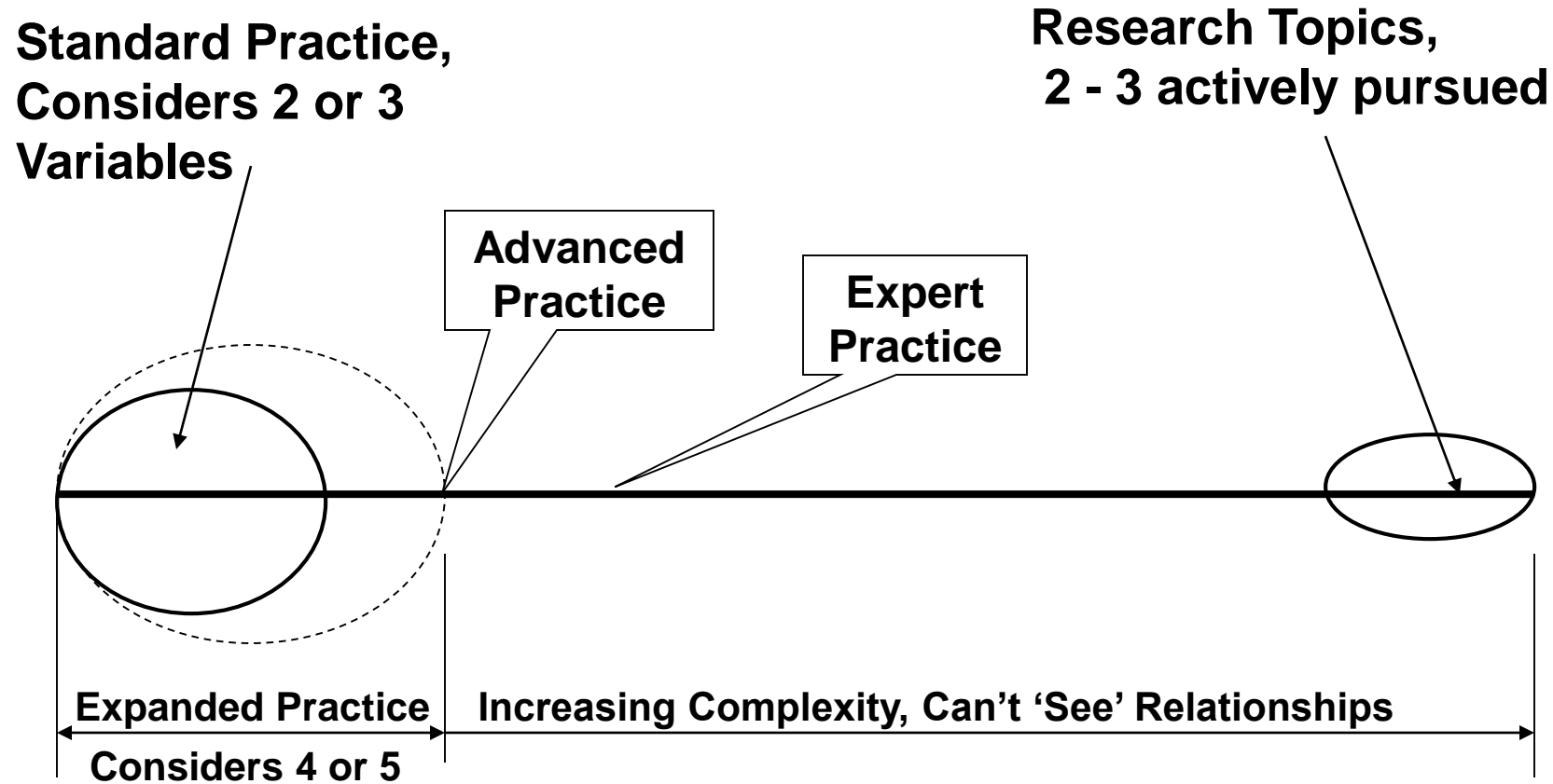




# Need to treat our Engineering Profession with Respect!

- Our ASCE code of ethics states that:
  - First and foremost, protect the health, safety, and welfare of the public; **Does this mean protect the \$ ? Remember that the “public” are people.**
  - And it also says - Uphold the honor, integrity, and dignity of the profession; **What is integrity?**
- Integrity is doing the right thing, not just going through the motions.
- But what is the right thing? Often it depends on the problem as well as on us.

# What type of transportation projects do you work on?



When are correlated parameters sufficient, and when do we need to do advanced field, geophysics, laboratory, and computer analyses?

# *New (2014) Developments becoming Standard Practice*

- **“The Graded Approach”** - Judgment to Apply the Appropriate Technologies to Problem Solution
- **Integration of Tools** – Prescreening of site by multiple geophysical methods, Testing by use of Borings and CPT tests, Advanced triaxial testing that is designed to provide appropriate parameters for project design rather than using correlations
- **Large geophysical arrays** – characterize large area on and around the project site to develop big picture
- **2D and 3D Finite Element Analyses** – New analyses are becoming available, BUT we need appropriate input parameters.

# Are we using the Right Tools?

- Principal and Senior Geotechnical Engineers are retiring. Some are even changing professions because of “stress”.
- We need experienced engineers to mentor young engineers.
- Experienced engineers can help us select the “Right Tools”.
- Faster and Cheaper are often not “better”. Integrity may require more thought on solving our “problems”.
- We need to respect our profession, work with integrity, and strive for excellence.

# Recommendations

- Study the latest FHWA GEC Manuals
- I highly recommend GEC 5, NHI-16-072
- Thank you to NMDOT and FHWA for the training received on “Geotechnical Site Characterization.”
- Thank you to Rich Finno for showing me the value of advanced triaxial testing.

Please remember: Respect, Integrity, Excellence



U.S. Department of Transportation

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**NHI Course No. 132031**

**Geotechnical Engineering Circular No.5**

**Geotechnical Site Characterization**

