NEES Workshop
Panel Discussion

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Question(s) 1

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From engineering standpoint, most pressing need is w/r/t strongly nonlinear response

- Nonlinearity due to large strains
  - Soft, weak soils – NC clays, organic soils
  - Strong shaking – large amplitudes, long periods/durations
- Nonlinearity due to pore pressure generation
  - Potentially liquefiable soils
    - Level ground – evolving freq. content, permanent settlement
    - Sloping ground – permanent lateral deformations
  - Sand vs. silt behavior – "clay-like" and "sand-like"

Question(s) 1

Are we making the right observations to improve our ability to simulate site response behavior? ***What type of sites are lacking in observations?***

Sloping sites

- One-dimensional - infinite slope cases
  - Asymmetric response
  - Permanent deformations
  - Simple modification of existing one-dimensional codes
- Two-dimensional – embankment or river bank
  - Multiple vertical arrays perpendicular to slope
  - Horizontal and vertical motions
    - Dynamic
    - Permanent

Question(s) 1

Are we making the right observations to improve our ability to simulate site response behavior? *What type of sites are lacking in observations?*

Need to focus on nonlinear layers

- Need to measure motions above and below layer(s) of interest
  - Extremely deep downhole instruments may not be helpful
  - Need reliable pore pressure measurements in appropriate soils
- Need to measure permanent deformations
  - Lateral deformations
    - inclinometers
    - shape arrays
  - Vertical deformations
    - Sondex tubes

Question 2

What are the important geotechnical site characterization parameters needed to simulate and predict site response behavior?

Shear wave velocity profile

- Soil
  - all layers
- Rock – define reference layer
  - weathered zone
  - rock layers (sedimentary / igneous)

Liquefiable soil profiles

- Permeability profile – void redistribution effects
  - Position / continuity of impermeable layers
  - Connectivity of permeable layers
- Plasticity profile

Question 3

Advantages and disadvantages to the various methods for computing site response behavior especially at large strain levels?

Equivalent linear

- Good approximation for low strain levels
  - Familiar
  - Simple, readily available material properties
  - How low is low?
  - What is nature of "error" relative to nonlinear?
- Soil has infinite strength
  - Modulus reduction (G/G_{max}) curves validated up to ~1% strain
  - Can trick into limiting shear stress by modifying G/G_{max} curve

Question 3

Advantages and disadvantages to the various methods for computing site response behavior especially at large strain levels?

Nonlinear

- More "correct" representation of behavior at low *and* high strains
- Can predict permanent deformations
- Can accommodate pore pressure generation
- Stress-strain models are more complicated
  - Unfamiliar
  - Material properties not readily available
  - Low-strain damping can be problematic
  - Large-strain damping may be incompatible w/ laboratory results
- Numerical issues more prevalent
  - Stability, numerical damping