In Situ Assessment of Scour Potential with Depth Using a Jetting Approach (ISEP)

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Design goals of this research:

- *Scour is a dynamic and transient process so frequent measurements of scour potential are necessary.*
  - *Current methods to measure scour potential require sample removal and lab testing or only provide surface measurements.*
  - *Goal is to provide estimate of scourability with depth.*
- *Device must be easily portable and provide rapid assessment of scourability under a variety of field condition.*
  - *Minimize crew and probe's ancillary equipment necessary for operation.*

Anticipated uses of the ISEP for:

- *Assess the vulnerability of protective earth structures.*
- *Provide guidance during preconstruction by assessment of scour potential at critical locations of proposed structure.*
- *Identify scour-critical structures for guidance of maintenance and hardening decisions.*
- *Provide data to compare pre-storm versus post-storm stability and to track time-variation of stability of critical structures.*

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- Cone Tip
- Rod Sections
- Coaxial Sheathing
- Pump
- Controller

Vary Flow Rate-
Maintain Velocity

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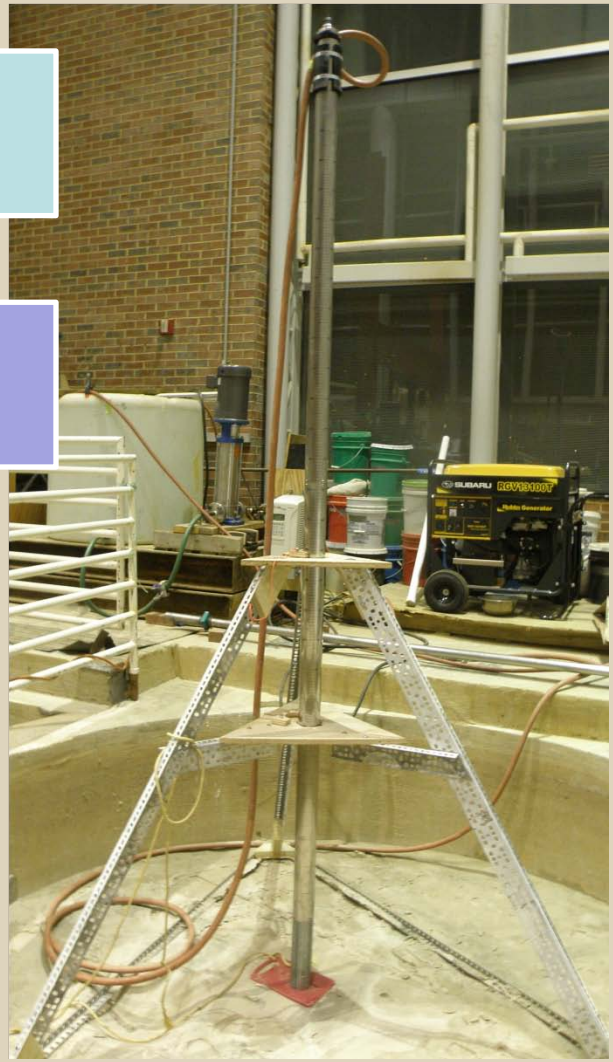
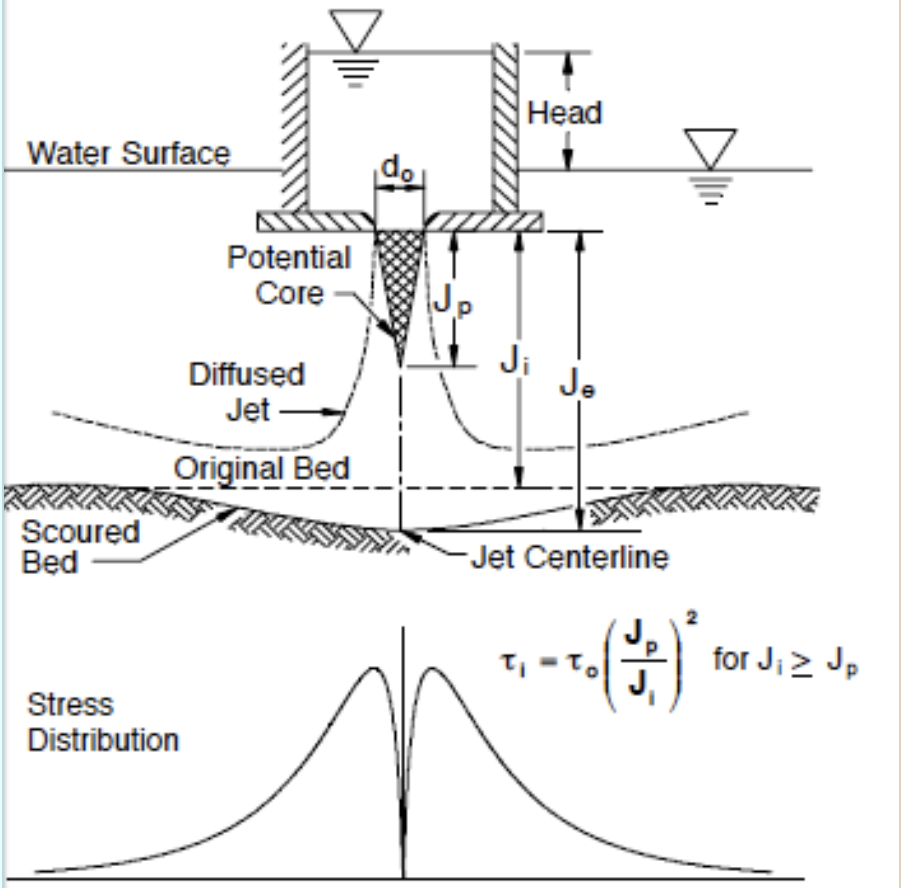
Maintain Flow Rate



- A vertical water jet strikes the soil surface and is deflected horizontally thus applying a bed stress to the soil. The applied shear stress (τ_e) is a measure of the hydrodynamic drag which is related to the water velocity.

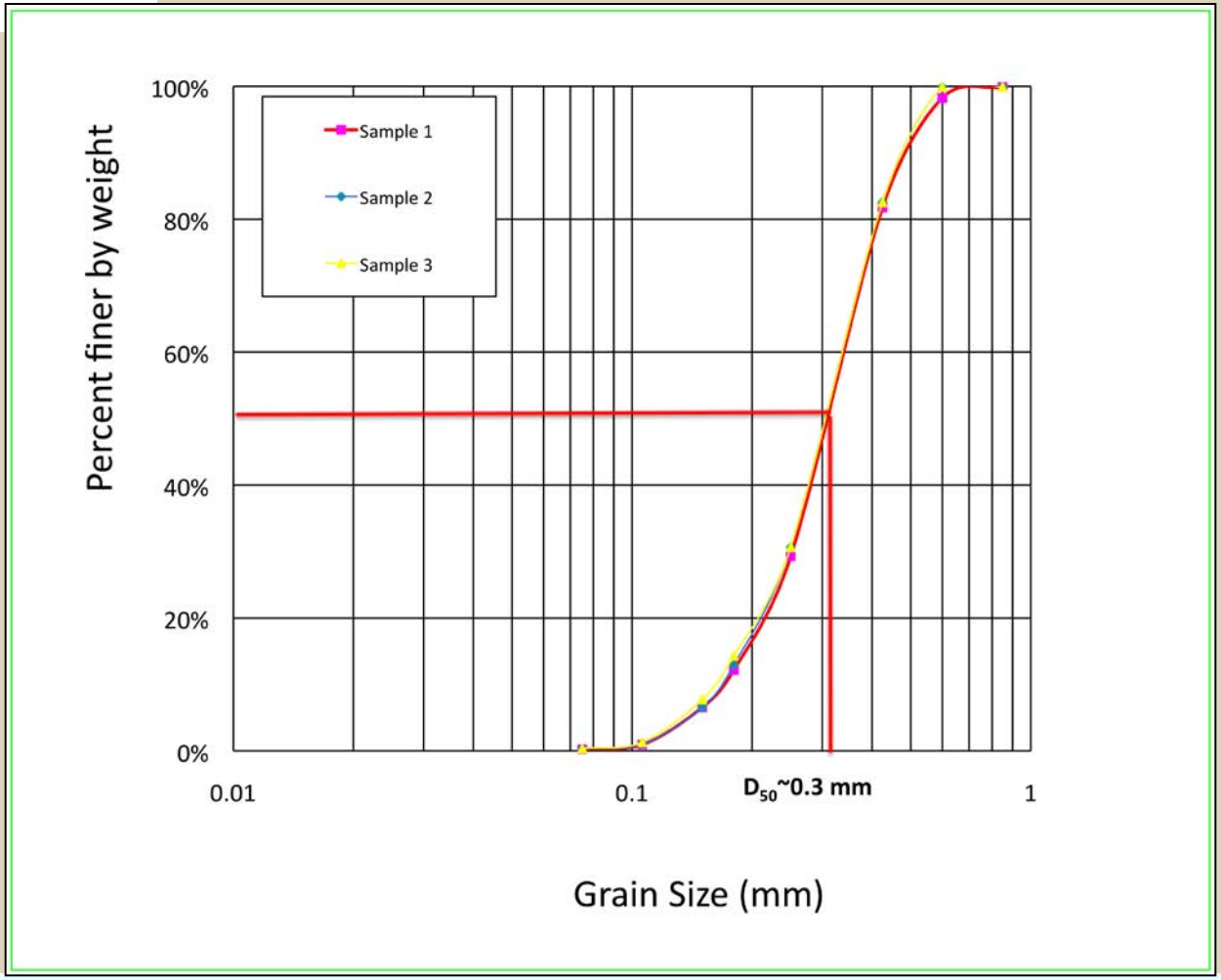
- The excess shear model is used to estimate erosion rate:
  $E = k_d(\tau_e - \tau_c)$
  k_d= erodibility coefficient
  τ_e = bed stress
  τ_c=critical stress.

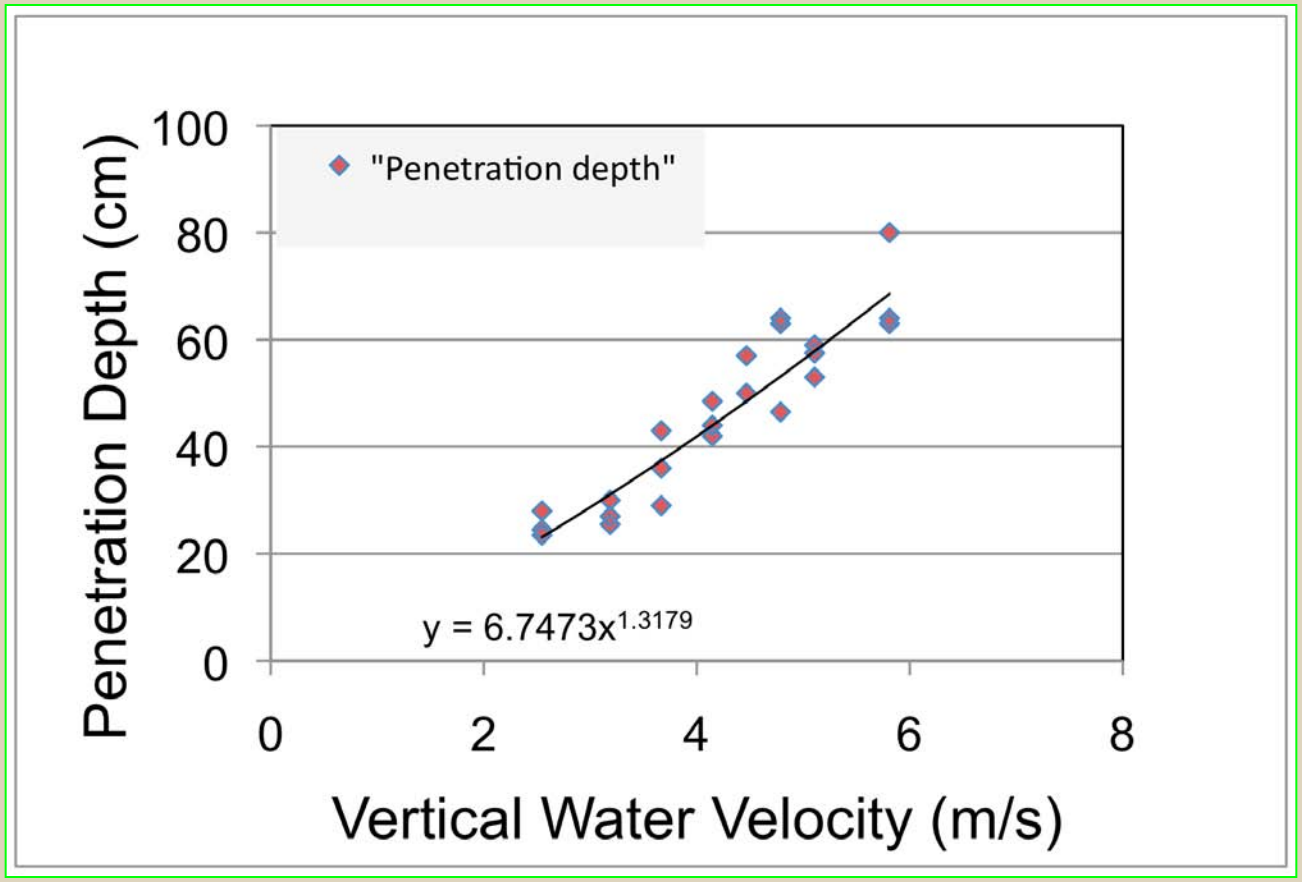


Schematic of vertical jet apparatus and the resulting stress distribution, from Hanson and Cook (2004)

Proposed Testing Procedure: modified from ASTM Standard D5852 (2007): *" Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method"*

- Basic data collected: Rate of Penetration,Time and Scour Depth
  - Time and Scour Depth data, for a given water velocity, allows calculation of coefficient of erodibility (k_d) and critical stress (τ_c)
- Proposed two-step process similar to Hanson&Cook(2003):
  i. Determine the critical stress (τ_c) on the basis of scour depth (J_p) and estimates of maximum depth of scour (J_e)
  ii. Determine scour rate by calculation of k_d from estimation of τ_c and dimensionless time parameters.



Sand in the test pit is a clean, sub-angular silica sand from a quarry near Sanford, NC. D_{50} ~ 0.3 mm

Penetration Depth vs Water Velocity