

Penetrometer

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11-18-2025

Methods and Measurements

The drop cone method measures the depth of penetration resulting from a cone of fixed mass being dropped from a standard height. The hammer-type penetrometers use a slide hammer of fixed mass and drop height to apply consistent kinetic energy with each blow. Either the number of blows required to penetrate a specified depth, or the depth of penetration per blow are measured in this method.

Soil penetration resistance R_s is defined as the work done by the soil divided by the distance the penetrometer travels:

$$R_s = \frac{W_s}{P_d}$$

where R_s is the soil resistance (N), W_s is the work done by the soil (J), and P_d is the distance the penetrometer travels (m).

The kinetic energy of a hammer of mass $m = 4.58$ kg falling a distance $x = 0.45$ m is:

$$v = \sqrt{v_0^2 + 2ax} = \sqrt{0 + 2(9.8)(0.45)} = 2.97 \text{ m/s}$$

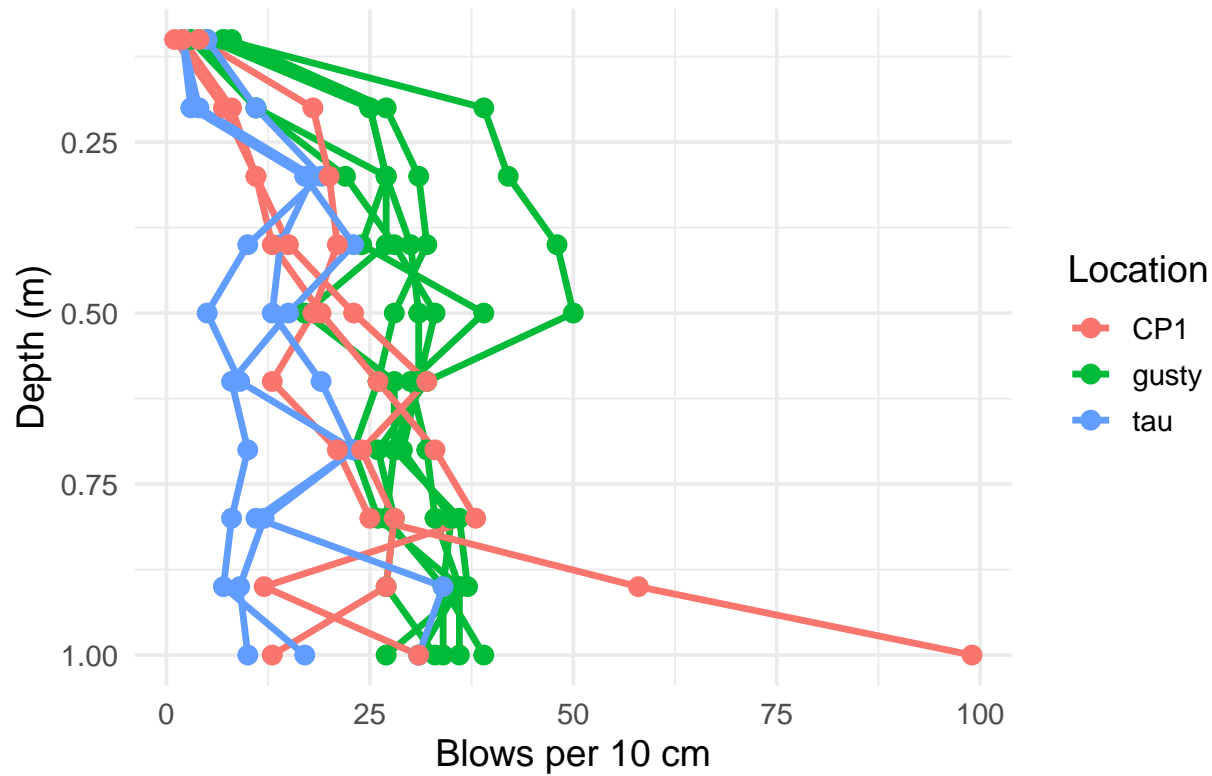
$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(4.58)(2.97)^2 = 20.20 \text{ J}$$

Then the soil resistance is calculated as:

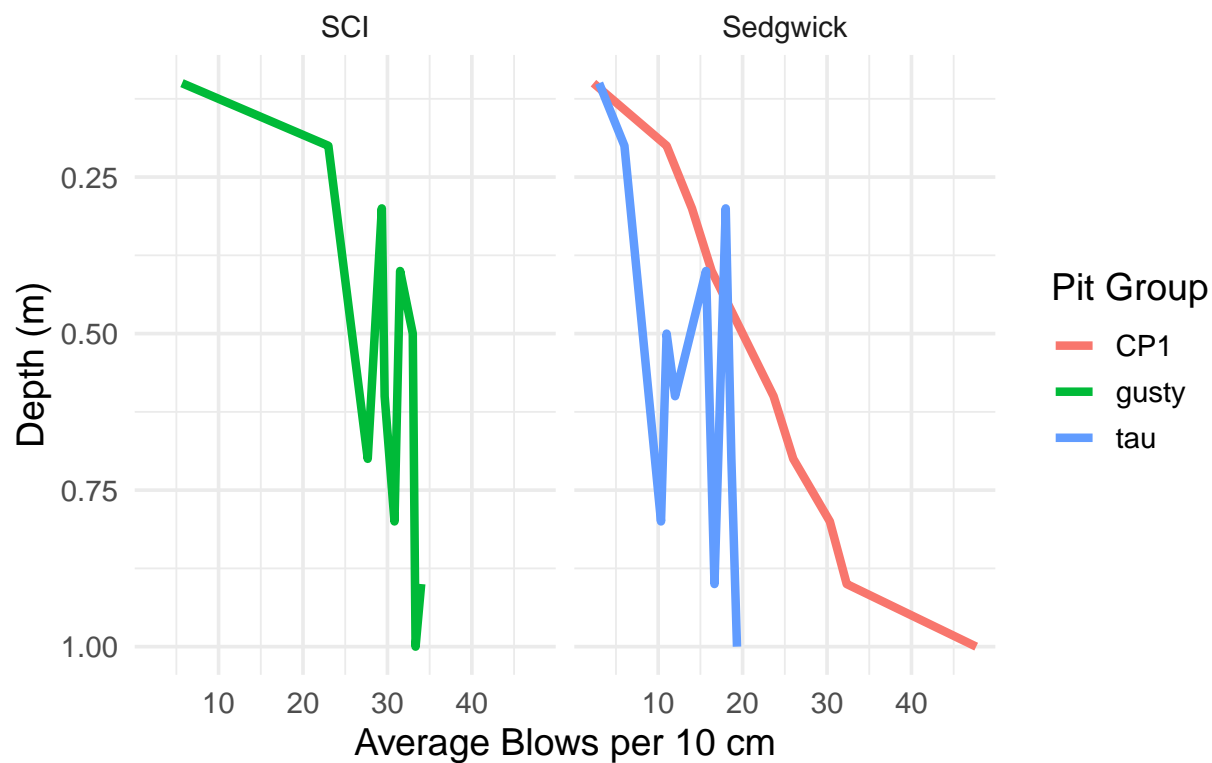
$$R_s = \frac{W_s}{P_d} = \frac{KE}{P_d}$$

$$P_d = P_d \text{ blows}/m$$

Penetrometer Blows by Depth Across Locations



Mean Penetrometer Blows by Location and Pit Group



Mean Blows vs Depth by Location

