Revetment Design

Calculating the weight of rock needed to resist the up-lift forces of waves.

Hudson's Equation

$$W_{50} = \frac{\gamma_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

(play long enough with waves and rocks and maybe you can get an equation named after you!)

WES hydraulics consultants conference, 1948 (from left): R. L. King, Eugene H. Woodman, Robert T. Knapp, Robert Y. Hudson, Hunter Rouse, Thomas E. Murphy, Arthur T. Ippen, Eugene P. Fortson, Frederick R. Brown

Robert Y. Hudson was the chief of the U.S. Corps of Engineers Water Wave Branch Waterways Experimental Station in Vicksburg, Mississippi. Hudson literally wrote the books on designing rubble-mound breakwaters to withstand the force of wave action.

Where:

- W_{50} is the 50th percentile (median) weight of the stone (lbs)
- γ_r is the unit mass of the stone (lb/ft^3); limestone typically is 160-165 lb/ft^3
- H is the design wave height (ft) at the toe of the structure
- $S_r = \gamma_r / \gamma_w$; (γ_w = 62.4 lb/ft^3)
- K_D is the stability coefficient, an empirical value based on physical testing. For randomly placed, angular stone K_D = 2.0
- cot θ is the design slope of the revetment. For a 2:1 slope, cot θ = 2

Hudson's Equation is "empirical."

- Empirical means the equation is based on testing in the real world.
- Empirical equations usually have a "K" factor to allow the test data to fit different types of conditions.
- "K_D" is a constant value based on the type of rock and arrangement in the structure.