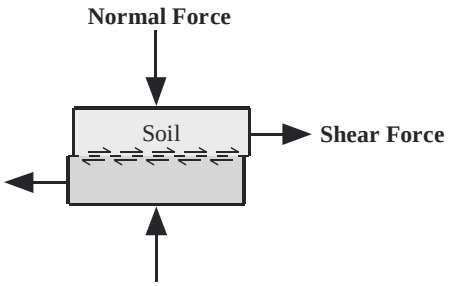
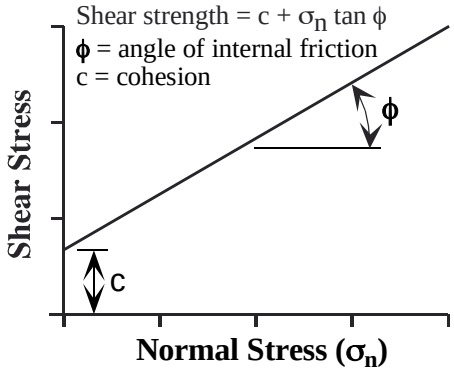
Soil Strength

Soil strength is a complicated geotechnical concept to simplify due to the inherent complexities of different soil types. Frictional strength, cohesive strength, and porewater pressure relationships are all integral to the effective strength determination of a soil but are only easily identified in the most select granular materials.

For the purpose of this brief discussion, all soils are assumed to be drained with no pore pressure considerations. Cohesion is typically neglected in the simplified design methods and a frictional strength relationship (ϕ and γ only) is utilized to determine driving and resisting forces. The figures below show the basic soil strength relationship.



Soil Shear Test



Plot of Shear Stress

The values for ϕ and c can be determined by direct shear test for granular soils and by triaxial testing for cohesive soils. Unit weight (γ) can be estimated from Proctor density test data. There are significant differences between the properties of undisturbed in-situ soils, laboratory remolded soil samples, and contractor placed soils so careful evaluation of design properties vs construction considerations is required.

Laboratory testing of soils is desired but not always practical due to cost and time considerations so the following table is presented to provide design ranges for typical soil types.

Approximate Soil Design Parameter Ranges

Wall Backfill Classification	Common Description	UNSC Classification	ϕ range	γ range (moist)	Comments
Good	Sand, Gravel, Stone	GW, GP, GM GC, SW, SP	32° - 36°	100 - 135 pcf	Poor grading lowers weight (ie: #57 stone)
Moderate	Silty Sands Clayey Sands	SM, SC	28° - 32°	110 - 130 pcf	Moisture Sensitive
Difficult	Silts, Low Plastic Clays	ML, CL, OL	25° - 30°	110 - 125 pcf	PI < 20 LL < 40
Bad	High Plastic Silts & Clays, organics	CH, MH OH, PT	0° - 25°	50 - 110 pcf	PI > 20 LL > 40