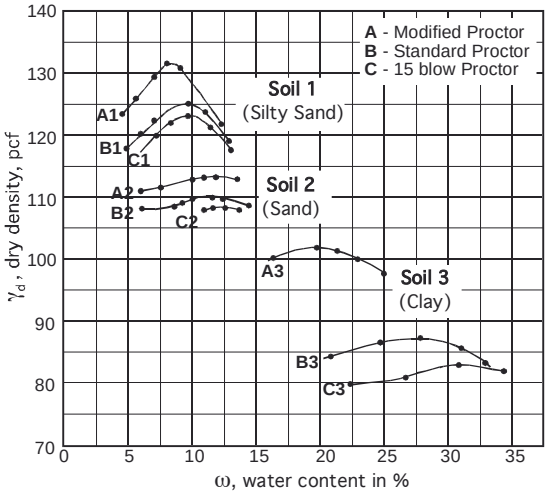
# Soil Density - Standard vs Modified Proctor

Reinforced soil structures routinely specify that all soils be compacted to 95% of the maximum density determined by ASTM D698 - *Standard Proctor Density* for conformance with the design. However, *Standard Proctor* density criteria is typically utilized in the Eastern US whereas *Modified Proctor* density criteria is typically utilized in the Western US which can create some conflicting specification problems.

Research has been done showing the relationship between *Standard* and *Modified Proctor* density testing for different soils types as indicated below:




**Moisture-Density Relationships**
(Ref. Tschebotarioff - 1973)

**Characteristics of Three Soils**

| Type | Sand | Silt | Clay | LL | PI |
|---|---|---|---|---|---|
| Soil 1 - Silty Sand | 80% | 15% | 5% | 17 | 1 |
| Soil 2 - Sand | 92% | 5% | 3% | NP | NP |
| Soil 3 - Clay | 10% | 28% | 62% | 68 | 47 |

**Summary of Data**

| Type | Max Dry Density,pcf | | | Optimum Moisture,% | | |
|---|---|---|---|---|---|---|
| | A | B | C | A | B | C |
| Soil 1 - Silty Sand | 132 | 125 | 123 | 8 | 10 | 10 |
| Soil 2 - Sand | 113 | 110 | 108 | ind | ind | ind |
| Soil 3 - Clay | 102 | 88 | 83 | 20 | 28 | 31 |

**95% Standard vs Modified Proctor Comparison**

| Type | Standard | 95% Standard | % of Modified |
|---|---|---|---|
| Soil 1 - Silty Sand | 125 | 119 | 90% |
| Soil 2 - Sand | 110 | 105 | 93% |
| Soil 3 - Clay | 88 | 84 | 82% |

It is obvious from this limited data that a simple conclusion can not be drawn but some general guidelines can be established when using *Modified Proctor* density testing in lieu of *Standard Proctor* testing for quality assurance testing of reinforced soil structures:

* 90% - 92% of *Modified Proctor* density is roughly equivalent to the specified 95% *Standard Proctor* density except for fine grained soils (ie: clay) where the difference may be significantly larger.

* *Modified Proctor* testing typically requires a lower optimum moisture content for achieving maximum density which is desirable for Keystone retaining wall construction and performance especially with silts and silty soils.

* The density difference between *Modified Proctor* and *Standard Proctor* density testing appears to increase with the percentage of fines in the soil matrix while the optimum moisture content decreases . It may be prudent to utilize 90% of Modified Proctor density and optimum moisture content when working with fine grained soils such as clays for best results.